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Report to the Chairman, Subcommittee on Aviation, Committee on Public Works and Transportation, and the Honorable Bruce F. Vento, House of Representatives

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AIRCRAFT NOISE

Eight Airports' Efforts to Mitigate Noise

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The Honorable James L. Oberstar
Chairman, Subcommittee on Aviation
Committee on Public Works and Transportation
House of Representatives

The Honorable Bruce F. Vento
House of Representatives

As requested in your July 15, 1988, letter, we are providing information on airports' efforts to mitigate aircraft noise. As agreed with your offices, the summary information contained in this report is based on case studies of eight major airports serving the cities of Atlanta, Baltimore, Chicago, Los Angeles, Memphis, Minneapolis-St. Paul, Philadelphia, and San Francisco. Both the case studies, details of which are contained in appendixes III through X, and this report provide information on

- the processes that airports used to select measures for mitigating the effects of aircraft-generated noise,
- the specific measures that airports have taken,
- the Federal Aviation Administration's (FAA) actions to assist airports in developing their noise mitigation programs, and
- airports' evaluations of the effectiveness of individual noise measures and their programs as a whole.

Results in Brief

According to airport officials and our analyses of their noise abatement programs, no quick or simple solutions to the aircraft noise problem exist. Moreover, compromise among the conflicting interests of communities, airlines, and airports is often the only avenue to alleviate the problem. A summary of our findings at the eight airports we visited follows.

- In selecting noise mitigation measures, airports have attempted to balance local and national needs. To address its specific conditions, each airport has selected a unique combination of measures based on such factors as the need to maintain or increase capacity, community desires, local government ability to control land use, aviation safety, and

whether any proposed measures impose a burden on interstate commerce. In each case, the consultative process used was similar. The airports involved community, airline, FAA, and airport representatives in their efforts to develop noise abatement programs.

- Airports have taken many actions to control noise, such as changing the way aircraft approach and depart the airport, thereby reducing off-airport noise or shifting it to less sensitive areas. On the other hand, airport and community support for land use measures, including zoning for compatible use and property acquisition, was varied, with few airports implementing measures that would disrupt established communities or impinge on communities' rights to control land use
- FAA has provided technical and financial assistance to airports for developing and implementing noise control programs and two of the eight airports we visited were satisfied with FAA's assistance. However, five airport operators believe that FAA could provide more explicit guidance on the information that airports must submit to obtain noise program approval, be more consistent in applying program review criteria to airports' applications, or review noise programs in less time. In addition, four airport operators are concerned that sufficient federal funding may not be available to implement noise programs once FAA approves them. FAA is providing information on these and other concerns in a report to be issued in October 1989.
- Although airports generally assess the expected effects of individual noise mitigation measures before they are implemented, postimplementation assessment is rarely done primarily because of the difficulty of evaluating the effects of a single measure while holding all else constant. Airports have, however, considered or plan to consider the effects of their noise programs as a whole over time and modified them as they planned for future airport development or otherwise assessed their noise impacts.

Background

FAA estimates that approximately 3.2 million Americans currently experience noise levels of 65 or more decibels, on the day-night noise level (Ldn)[1] scale, caused by aircraft operations near airports. With this impact and the threat it poses to airport expansion and capacity, aircraft noise near airports has become a sensitive and controversial issue.

[1]Ldn measures cumulative sound over a 24-hour period to determine an average annual noise level at a specific location. The 24-hour sound level is adjusted by adding a 10-decibel penalty to nighttime (10:00 p.m. to 7:00 a.m.) noise to account for increased annoyance from noise during that period. Sixty-five or more Ldn annoys people by interfering significantly with routine daily activities; it is the threshold above which federal agencies consider land incompatible for residential use. A more comprehensive discussion of the Ldn measure can be found in our report Aircraft Noise: Implementation of FAA's Expanded East Coast Plan (GAO/RCED-88-143, Aug. 5, 1988).

Despite the noise, people continue to live in communities surrounding the 8 airports we visited and about 475,000 people experience noise levels of 65 or greater Ldn. The number of people affected ranged from about 825 at Philadelphia to over 200,000 at Chicago's O'Hare. (See app. I for comparative information on the affected populations, airport operations, and noise complaints at the eight airports.)

Under Section 611 of the Federal Aviation Act, FAA is responsible for regulating aircraft noise at its source. One way it accomplishes this is by classifying civil transport aircraft into three stages—Stage 1 being the loudest and Stage 3 being the quietest— depending on how much noise they generate. To reduce the noise generated by the U.S. fleet, FAA banned the operations of aircraft that were not certificated as Stage 2 or 3 from flying in the United States as of 1985. This resulted in an effective ban on the operations of most Stage 1 aircraft. In addition, according to FAA officials, any new transport aircraft designs submitted to FAA for certification must be Stage 3. Of the 3,650 aircraft in the U.S. fleet, 1,334 are Stage 3 and 2,316 are Stage 2. At the request of the Congress, FAA is currently analyzing public comments on how a new "fleet modernization" policy should be framed. Such a policy could result in a ban or gradual phaseout of all Stage 2 aircraft from U.S. use. If this change occurs by the year 2000, it would reduce the number of people exposed to aircraft noise of 65 Ldn or greater to about 400,000, according to a September 1987 report from the Industry Task Force on Airport Capacity Improvement and Delay Reduction.

Airports are responsible for controlling aircraft noise and mitigating its effects in the immediate vicinity of airports (Griggs v. Allegheny, 369 U.S. 84 (1962)). Under the Aviation Safety and Noise Abatement Act of 1979, FAA assists airports in developing programs to accomplish this mitigation to ensure that the programs are consistent with safe air traffic operations and do not unduly burden interstate commerce. Under this act, FAA also provides airports with an incentive to control noise and provides for funding airport noise control programs subject to FAA's approval. While airport programs are not mandatory, minimum annual amounts of airport improvement program funds are set aside for planning and implementing noise control programs. To implement the act, FAA developed a means for airport operators to plan and be funded for compatible land use near their facilities. Called the "Part 150 program," its purpose is to encourage airports to prepare noise exposure maps showing areas of land uses incompatible with noise levels of 65 Ldn or greater and to propose a program to reduce this incompatibility. After

FAA's acceptance of the proposed program, the airport is eligible for federal funding to implement approved noise mitigation projects. From fiscal years 1982 through 1988, FAA obligated $575 million under the act's amendments.[2]

Airports Consult With Communities and FAA to Select Noise Measures

In developing their noise programs, the airports formed advisory committees to identify, analyze, and recommend noise control measures. The committees, generally working with consultants hired by the airports, included representatives from neighboring communities, planning agencies, airlines, and FAA. Airports and their advisory committees tried—not always successfully—to maintain a harmonious balance among the airports' operational needs, community desires, and FAA requirements. For example, because of complaints from the city of El Segundo, California, the Los Angeles airport required aircraft using a remote terminal to be towed to and from the runway area, thus reducing noise in a manner approved by all. In contrast, in a controversial action that was opposed strongly by one community, Minneapolis tested a proposed change to how it uses its runways so that it could more evenly distribute the noise among the surrounding communities. Although the test results have been made public, a decision on whether to implement the proposal has not been made.

Airports generally worked with communities, and together they structured land use measures. For example, Memphis and Atlanta received local community support in carrying out large-scale residential land acquisition programs. However, because land use measures in Chicago are under control of 29 local communities, the airport has been unable to achieve a consensus to implement land use measures.

As they developed noise control measures involving air traffic operations, airports consulted with FAA because in some cases the agency must approve the measures because of safety considerations. FAA's concerns for safety or efficiency could override noise control considerations and result in FAA's disapproval of proposed changes to operational procedures. For example, Los Angeles proposed adding 2.5 hours to the nighttime period during which aircraft use a specific flight track to reduce the population affected by noise by about 25 percent, or 13,000 people. However, FAA did not approve the proposal because it believed

[2]For a discussion of federal requirements to reduce aviation noise and FAA's Part 150 program, see our forthcoming report Transportation Noise: Federal Control and Abatement Responsibilities May Need to Be Revised (GAO/RCED-89-176).

that the measure might restrict the airport's operational capacity, increase flight delays, and impair coordination among air traffic controllers.

Under its charter in the Federal Aviation Act, FAA must foster competition and prevent unjust discrimination in the growth of interstate commerce. However, two airports—San Francisco and Minneapolis—took noise abatement actions that FAA believes would restrict interstate commerce. For example, San Francisco prohibited a Stage 1 Boeing 707 aircraft that had been modified to meet Stage 2 noise standards from using the airport. Because the modification occurred after FAA banned Stage 1 aircraft in 1985, the airport believed that its prohibition was justified. Nevertheless, because FAA believes that in this case its goal of not unjustly discriminating among air carriers overrides the airport's noise abatement goal, the agency has withheld airport improvement grant funds and sued the airport.

Airport Actions to Mitigate Aircraft Noise

Each of the eight airports we visited faced different circumstances that limited the types of noise control actions it could take. These differences related to their physical locations, level of operations, and relationships with surrounding communities. As a result, the airports' noise control programs contain unique sets of noise control measures.

For our analysis of airports' noise control measures, we categorized the 25 types of distinct actions (see app. II) that airports could take[1] into 4 broad categories: (1) operational changes in use of the airport, aircraft, or airspace; (2) land use controls; (3) physical modifications to the airport; and (4) noise management and community involvement processes.

With the exception of Philadelphia, each airport implemented or plans to implement at least one noise control measure in each broad category. Philadelphia is surrounded by old industrial areas and the Delaware River and, consequently, has only about 825 people living in areas experiencing noise levels of 65 Ldn or greater. The airport, therefore, has not implemented any land use measures or modified airport facilities. (See the glossary for a definition of each noise control measure.)

[1]A 1980 FAA report, A Guidance Document on Airport Noise Control, presents a matrix of noise control actions an airport can take and discusses the costs and benefits of the various measures. This report is the basis for FAA's noise mitigation guidance for airports.

As shown in appendix II, most of the airports included operational, land use, and noise program management measures in their noise control programs. None, however, made physical changes to their airports except to erect noise barriers or establish locations for conducting engine run-ups. Generally, operational and program management measures can be implemented by the airports themselves or with FAA's involvement. Implementation of land use measures, on the other hand, generally requires cooperation from the local communities and substantial funding. Where such measures have been most difficult from a political or cost standpoint—for example, in Chicago and San Francisco—they have not been used as frequently as in other cities. Nevertheless, most airports used several aspects of land use control to abate aircraft noise.

Airports' Concerns About FAA's Role

FAA, through its Part 150 program, provides airports with financial and technical assistance in developing and implementing their noise programs. Technical assistance is in the form of guidance on preparing the program application documentation and advice on the effect on air traffic of a proposed noise abatement measure. Though two airports were satisfied with FAA's assistance, five airports were dissatisfied with FAA's technical assistance or program review and approval actions. Four are concerned about the sufficiency of future grant funds for noise mitigation projects because of increasing airport participation in the Part 150 program.

Part 150 Program Participation

The seven airports with noise problems—Philadelphia is the exception—either currently participate in FAA's Part 150 program or have received varying amounts of funds from the airport improvement grants set aside for noise projects (see app. I) and technical assistance from FAA field offices. Since 1982, funding for the seven airports to develop and implement noise mitigation programs ranged from $116,000 for Minneapolis to $116 million for Atlanta.

Four airports—Atlanta, Los Angeles, Memphis, and San Francisco—met FAA's Part 150 program requirements and have approved noise compatibility programs. However, Baltimore, Minneapolis, and Chicago are at various stages of Part 150 program development; and as of July 1, 1989, none have had their noise exposure map or noise compatibility program approved by FAA.

Views on FAA Assistance and Review/Approval Actions

Airports' views on the adequacy of FAA's technical assistance and program guidance for developing noise mitigation measures under the Part 150 program and on the consistency of FAA's review and approval actions varied. The operations and planning officials of two airports expressed general satisfaction with FAA's actions. On the other hand, officials at five airports were concerned about

- the amount of technical assistance FAA provides and the lack of clear, consistent guidance on program requirements and on the acceptability of specific noise mitigation measures;
- inconsistencies in how FAA regional offices and headquarters apply noise program review criteria; or
- the amount of time—about 4 years in some cases—for an airport to work through the entire process of noise program development and approval.

We believe that these concerns were addressed when the Congress enacted the Airport and Airway Safety and Capacity Expansion Act of 1987, which required FAA to report on (1) the process and standards used to review Part 150 programs, (2) noise abatement proposals currently ineligible for federal financial assistance, and (3) whether Part 150 program procedures could be expedited and simplified. FAA has provided the information for the first two issues and will report on the third issue in October 1989, according to FAA officials, although mandated to do so by June 30, 1989.

Some Airports Question Funding Availability

Availability of federal noise mitigation funds was a key factor influencing airports' decisions to participate in the Part 150 program. However, airports also expressed concern about the continued availability of sufficient set-aside airport improvement funds to implement the noise mitigation programs developed under FAA's Part 150 program. Because of growing airport participation in the program, officials at Baltimore, Chicago, and Minneapolis have been concerned that sufficient and timely funding might not be available to meet the growing public expectations for quick reductions in the impact of aircraft noise. Philadelphia, while not participating in the program, shares similar concerns.

FAA officials, however, believe that although 3,000 airports are technically eligible to participate in the Part 150 program, only about 400 to 500 airports have or could have noise problems significant enough to justify the application and would therefore benefit from participating. According to the latest data available from FAA, as of December 1, 1988,

165 airports had received grants to prepare Part 150 studies, and 41 had approved noise compatibility programs.

Noise Program Evaluation

Airports have evaluated, or plan to evaluate, the overall effects of their noise mitigation efforts. These evaluations, conducted as separate noise program evaluations or as part of broader airport or FAA planning or environmental studies, have led to noise program modifications in some cases. Airports find it difficult, however, to accurately assess the effects of individual measures after they are implemented because of the small reduction in total noise contributed by such measures and the difficulty in distinguishing between their effect on noise and the effects of other factors over time.

FAA Guidance and Assistance in Program Evaluation

FAA, through its Part 150 program guidance, requires airports to forecast the potential impacts of noise mitigation measures or programs on airport operations and the surrounding communities. This guidance does not require airports to evaluate the effects of individual noise mitigation measures after implementation. However, it encourages periodic program assessment and requires airports with noise programs approved under the Part 150 program to revise them if, because of a change in the airport's operation, noise increases significantly—when the sound level, measured as Ldn, increases 1.5 decibels or more. Finally, agency guidance requires FAA to assess the potential environmental impacts—including noise—of major changes to the airport or aircraft operations, if necessary, and to develop measures to mitigate undesirable impacts. Thus, airports can reach evaluation and modification of their noise programs by different routes.

In developing their noise programs, airports evaluate the potential impacts of alternative noise mitigation measures. Although these evaluations are generally based on the results of computer modeling, FAA will, at an airport's request, test proposed aircraft operational changes to determine the actual effects of the change. Other than determining whether a proposed change can be safely and efficiently implemented, FAA leaves it to the airport to determine how the test results will be evaluated and whether the proposed change will be implemented.

Since 1982, FAA has performed operational tests of noise mitigation measures for five of the eight airports we visited. For example, in January 1989, FAA completed a 6-month test of a revised runway-use system

at Minneapolis. The revised system would replace the current preferential runway-use system, which increased traffic had rendered ineffective in spreading noise among the surrounding communities. The test was intended to assess air traffic controllers' ability to operate efficiently with the revised runway-use system, provide the basis for assessing the environmental impact of the new runway-use system, and identify community reaction to the noise level generated under the new procedures. On July 10, 1989, FAA and the airport released the results of the test but still had not determined whether to recommend that the revised procedures be adopted.

Airport Noise Program Evaluation

Airports generally have assessed or plan to assess the effectiveness of their overall noise programs in reducing the number of people experiencing noise levels of 65 Ldn or greater. While none of the four airports with approved Part 150 noise compatibility programs had revised their noise programs because of noise level increases, three of them— Atlanta, Los Angeles, and San Francisco—had conducted some evaluation of their noise program's overall impact. Los Angeles, for example, addressed the effects of, and suggested changes to, its current program in a study addressing the environmental effects of future airport improvements. Memphis, which had its Part 150 program approved in February 1988, has not yet evaluated its program's impact.

The other four airports also have evaluated (Baltimore and Philadelphia) or plan to evaluate (O'Hare and Minneapolis) the effects of their programs. For example, Baltimore in 1988 completed a program review required under state law and subsequently revised, expanded operational noise control measures, and implemented land use compatibility measures. Philadelphia also assessed its noise impacts as part of a 1987 update of its airport development plan and found that the amount of noise-affected land had decreased since 1980.

Conclusions

Aircraft noise has become a significant national issue that threatens the continued growth of airports and their ability to serve the growing demands of the air transportation industry. In developing their programs to reduce the effect of this noise, airports have had difficulty balancing the conflicting needs and desires of the surrounding communities with (1) regional, airline, and airport desires for growth and (2) FAA's responsibilities for maintaining a safe, efficient, and competitive air transportation system. We found that coping effectively with these

varied interests is a key factor in airports' ability to plan and implement satisfactory solutions to their aircraft noise problems.

Also hindering airport operators' ability to solve their noise problems is their lack of control over the land surrounding them and their dependence on local communities and states to cooperate in implementing land use control measures, such as zoning for compatible uses. These measures, together with expensive property acquisition, are the only ways to ensure long term compatibility of the surrounding land.

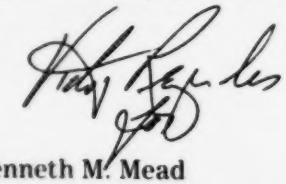
Beyond land use compatibility, no single solution exists to the noise problem. Therefore, as new airports are planned or as existing airports plan for expansion, responsible airport planners need to address noise early to avoid being precluded—as were Chicago and San Francisco—from implementing significant land use control measures.

Agency Comments

We discussed the results of our review with officials of each airport we visited and obtained their concurrence with the facts presented in each of the airport summaries in appendixes III through X. We also discussed the contents of the report with FAA officials and made revisions in accordance with their comments.

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to the appropriate congressional committees, the Secretary of Transportation; the Administrator, FAA; and to other interested parties. Major contributors to this report are listed in appendix XI.

If you have any questions, please contact me on (202) 275-1000.



Kenneth M. Mead
Director, Transportation Issues

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Abbreviations

CNEL	community noise equivalent level
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
GAO	General Accounting Office
Ldn	day-night average noise level

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Objectives, Scope, and Methodology

Objectives

In a July 15, 1988, letter, the Chairman of the Subcommittee on Aviation, House Committee on Public Works and Transportation, and Representative Bruce Vento expressed concern about what airports and the FAA are doing to reduce the impacts of airport noise on surrounding communities. In subsequent discussions with their offices we agreed to determine, for eight airports,

- how the noise mitigation actions were selected,
- what noise mitigation actions the airports have implemented or plan to implement,
- the actions FAA has taken in assisting the airports to develop and implement noise mitigation measures, and
- how the airports evaluate the effectiveness of individual noise mitigation measures that have been implemented.

Scope and Methodology

As agreed with the requesters' offices, we selected eight airports from which to obtain information on airport noise mitigation programs. To obtain an adequate geographic perspective, we selected two airports each from FAA's Eastern, Southern, Great Lakes, and Western-Pacific regions:

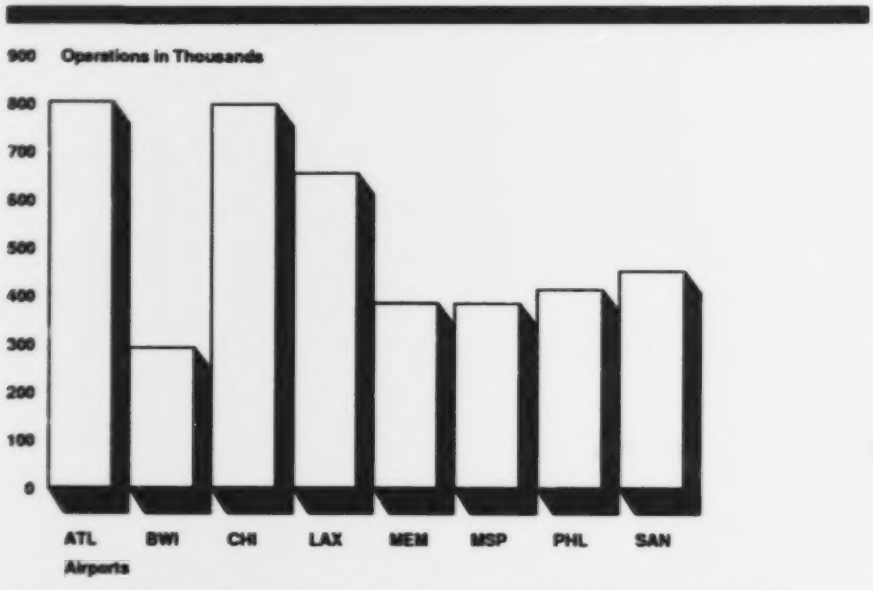
- Baltimore/Washington International Airport (Baltimore),
- Philadelphia International Airport (Philadelphia),
- Atlanta–Hartsfield International Airport (Atlanta),
- Memphis International Airport (Memphis),
- O'Hare International Airport (Chicago),
- Minneapolis-St. Paul International Airport (Minneapolis),
- Los Angeles International Airport (Los Angeles), and
- San Francisco International Airport (San Francisco),

In making our selection, we also considered the level of aircraft activity in terms of operations—takeoffs and landings—that each airport experienced and whether noise was perceived to be a problem at the airport. Except for Baltimore, each airport selected was among the 25 most active in the continental United States in 1987. For detailed information regarding each airport in our review, see appendixes III through X.

Figure I.1 shows the level of operations that each airport experienced in fiscal year 1987.

FAA reported that about 61 million aircraft operations took place in 1987 at airports with air traffic control towers. The eight airports we visited

Figure I.1: 1987 Total Aircraft Operations for Eight Airports



Key to airport abbreviations: ATL=Atlanta, BWI=Baltimore, CHI=Chicago, LAX=Los Angeles, MEM=Memphis, PHL=Philadelphia, MSP=Minneapolis/St. Paul, SAN=San Francisco.

experienced, in total, about 4.2 million, or about 7 percent, of these operations. As shown above, the number of operations ranged from 800,000 at Chicago and Atlanta to 290,000 at Baltimore. We also selected airports based on significant changes in activities in recent years. For example, Memphis is the home of an overnight air express company and has experienced an increase in nighttime operations as this industry grew. In addition, a major airline made Baltimore a hub—a connecting point where many flights begin or end—thus significantly increasing its annual operations within a short time.

Another factor we considered in selecting airports for review was whether or not an airport seemed to have a noise problem. We used FAA's May 1986 report, Airport Noise Control Strategies, and whether an airport participated in FAA's Part 150 noise compatibility planning program as factors to help select the airports for review. All airports except Philadelphia were participating in the program, and four airports—Atlanta, Memphis, Los Angeles, and San Francisco—have noise control programs approved by FAA. Baltimore, although not having an approved Part 150 noise compatibility program, was cited by FAA officials as operating under a state noise law that served as the model for FAA's Part 150

regulations. We chose Minneapolis because it appeared to have a severe noise problem as evidenced by the controversy over a revised noise mitigation runway-use system the airport was testing. We chose Philadelphia for the opposite reason: the airport was perceived as not having a noise problem. Figures I.2 and I.3 show each airport's most recent estimate of the surrounding communities' population that is experiencing noise levels of 65 Ldn or greater and the number of noise complaints received by each airport in 1988.

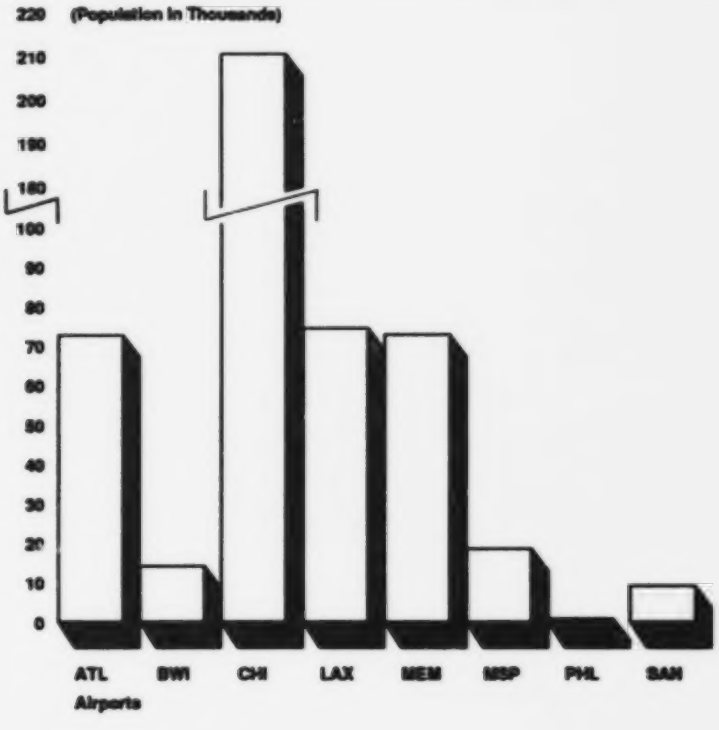
FAA currently estimates that about 3.2 million people are exposed to aircraft noise in excess of 65 Ldn. The eight airports we visited exposed a total of about 475,000 people to these noise levels, based upon the most recently calculated data for each airport.[1] As shown in figure I.2, the population residing within the 65 Ldn contour ranged from about 825 people at Philadelphia to 210,000 people at Chicago.

Seven of the eight airports had formal systems to accept complaints about aircraft-related noise. Complaints at the eighth, Philadelphia, are accepted by the FAA. As shown in figure I.3, the number of complaints received by, or for, an airport varied widely, from less than 25 at Philadelphia to 27,352 at Minneapolis. However, the number of complaints has no apparent correlation with the number of people subject to noise of 65 Ldn or greater. For example, Chicago, which has about 210,000 people subject to noise in excess of 65 Ldn, received about 12,500 complaints in 1988, the equivalent of about 1 complaint for every 17 people. Minneapolis, which subjects about 18,500 people to noise in excess of 65 Ldn, received about 27,000 complaints in 1988, the equivalent to almost 1.5 complaints per person.

Finally, except for Philadelphia, the airports each received FAA airport improvement grant funding to develop or implement noise compatibility programs. Figure I.4 shows the amount of such funding each airport received between fiscal years 1982 and 1988.

[1]The affected populations are not fully comparable between airports because of the different years for which data were computed and the different models used to calculate the exposed populations. Philadelphia and San Francisco provided only the number of dwelling units experiencing these noise levels. Therefore, we estimated the population using census data. In addition, the exposed populations for Los Angeles and San Francisco are calculated using a different noise measurement system—the community noise equivalent level (CNEL) measurement system. This measure differs from the Ldn measure used by the other airports because CNEL assigns a 3-decibel penalty to evening noise, 7:00 p.m. to 10:00 p.m., in addition to the 10-decibel penalty that is assigned to nighttime noise between 10:00 p.m. and 7:00 a.m.

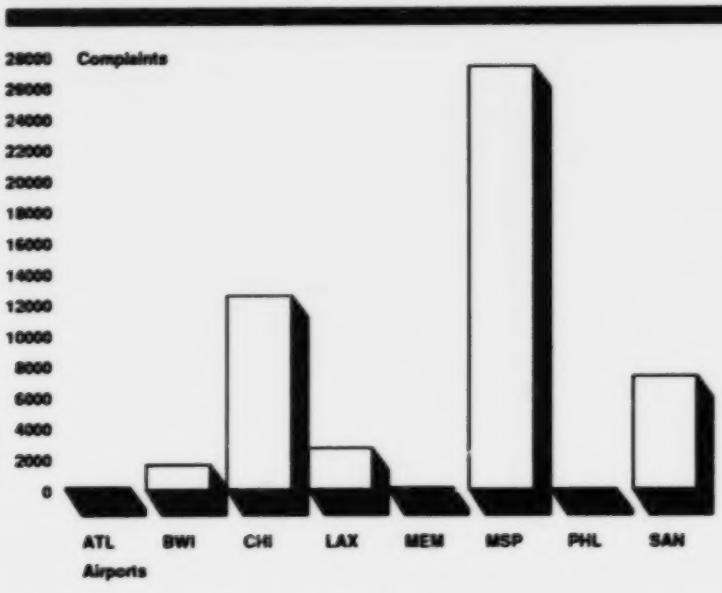
Figure I.2: Population Located in 65 Ldn and Above at Eight Airports



Between fiscal years 1982 and 1988, FAA obligated $575 million of noise set-aside funds. Seven of the eight airports we visited, (the exception was Philadelphia) received a total of $177.5 million, or over 30 percent of the national obligations, to develop and/or implement noise mitigation programs and projects during the same period. As shown in figure I.4, the amounts received ranged from $116,000 by Minneapolis to $116 million by Atlanta.

At each airport, we interviewed officials responsible for managing the airport's noise compatibility program. We discussed how and why the noise programs were developed, factors the airport considered in selecting the noise compatibility measures selected for implementation, the noise control actions themselves that airports have actually implemented, and how the airports evaluated the effects of individual noise compatibility measures. We also reviewed documentation relevant to the

Figure I.3: Noise Complaints for 1988 at Eight Airports

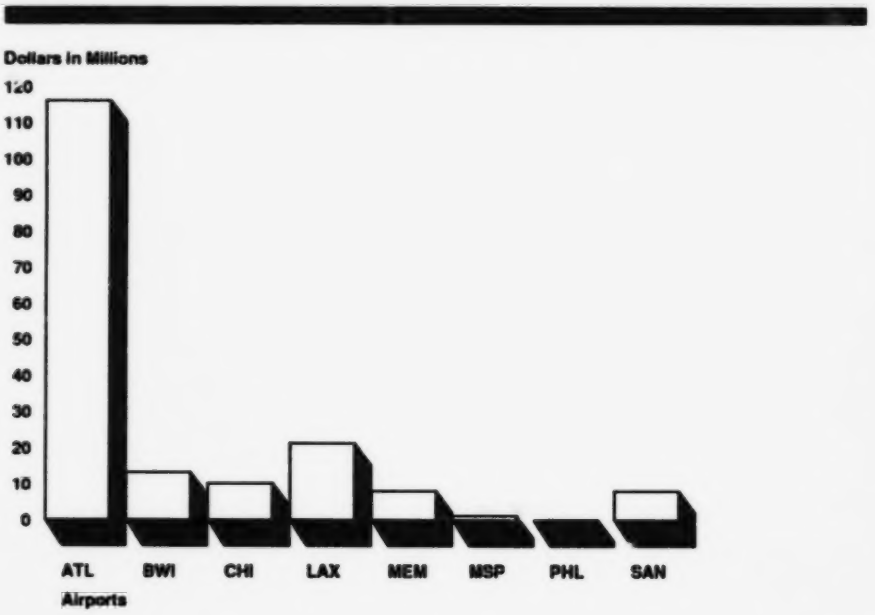


Note: ALT and MEM received 177 and 112 noise complaints respectively. PHL received less than 25.

airports' noise programs, such as pertinent laws, consultants' noise and airport planning studies, maps showing noise-affected communities, and noise programs submitted to FAA for approval under the Part 150 program. We also spoke to representatives of airport-sponsored community participation groups and independent local community groups concerned about airport noise at each airport where these groups existed to obtain their views on the airports' noise control efforts. We did not independently verify information provided to us by the airports. Although the eight airports are not statistically representative of all commercial service airports, we believe that they illustrate the processes followed and problems faced by airports in developing and implementing noise control programs.

In addition to visiting the airports, we discussed the airports' noise programs and the airports' concerns about FAA's assistance with the cognizant FAA regional offices. At these offices, we also obtained documentation relating to FAA's participation in the airports' noise program development process and FAA's review and approval of noise exposure maps and noise compatibility programs.

Figure I.4: FAA Airport Improvement Program Funding Obligations for Fiscal Years 1982 Through 1988



Note: MSP received $116,000 and PHL did not receive set-aside funds.

We conducted our review between July 1988 and May 1989 in accordance with generally accepted government auditing standards.

Noise Mitigation Actions Implemented (I) Or Planned (P) By Eight Airports

	Airport							
Noise measure	**ATL**	**BWI**	**CHI**	**LAX**	**MEM**	**MSP**	**PHL**	**SAN**
Operational procedures								
Runway-use system	I	I	I	I	I	I	I	I
Preferential flight track	I	I	I	I	I	I	I	I
Restrictions on aircraft ground movement		I		I		I		
Restrictions on engine run-up and ground equipment	I	I	I	I	I	I	I	I
Limits on operations/aircraft				I		I		I
Airport use restrictions						I		I
Raise glide slope angle or intercept		I				I	I	
Power/flap management	I	I	I		I	I	I	
Limit use of reverse thrust								
Land use controls								
Land or easement acquisition	I	I	P	I	I	P		
Joint airport development								
Compatible-use zoning	I	I		I[a]		I[a]		
Building code provisions	I					I[b]		
Sound insulation of buildings	I	I	I	I		I		I
Real property noise notices	I							
Purchase assurance		I				P		
Physical changes								
Runway alterations						P		
Displaced runway thresholds						P		I
High-speed exit taxiways								
Relocated terminals								
Isolate engine run-ups, noise barriers	I	I	I	I	I	I		
Noise program management								
Noise-related landing fees								
Noise monitoring		I	I	I		I	P	I
Citizen complaint mechanism	I	I	I	I	I	I	P	I
Community participation program		I	I	I	I	I	P	I

[a]The communities surrounding these airports have not achieved full compatible-use zoning. Some communities have changed zoning laws to recognize the effects of airport noise while others have not.

[b]Three of six communities surrounding the airport have adopted land use plans that address noise-related building codes, and the other three are developing or considering such plans.

Atlanta-Hartsfield International Airport Noise Mitigation Efforts

The Atlanta-Hartsfield International Airport (Atlanta) has made mitigating aircraft noise effects its current number one priority. In mitigating noise, the airport's main goals are to reduce noise without jeopardizing safety and the operational capabilities of the airport and to achieve and maintain long-term compatibility and encourage open communication between the airport and its surrounding communities. Atlanta has both stressed implementation of land-use compatibility measures and committed its airport improvement grants to purchase land and the rights to fly over other noise-affected land and to soundproof houses experiencing significant amounts of aircraft noise. Surrounding communities have cooperated with the airport by establishing compatible-use zoning laws and building codes. Implementing the noise program, which began in 1976, will cost about $400 million. As of January 1989, $219 million had been provided by federal and local sources.

Background

The Atlanta airport began regularly scheduled passenger service in 1930, is owned by the city of Atlanta, and is operated by the city's Department of Aviation. The airport is one of the busiest in the world, ranking first in annual aircraft operations in 1987 among airports in the United States. It experienced 802,000 operations in 1987, an increase of 35 percent over 1979. Atlanta serves as a hub for Eastern and Delta airlines.

Atlanta calculated that, in 1980, 81,183 people in 9 local jurisdictions resided within the 65 Ldn noise contour. Subsequent estimates of the noise-affected population have not been made. However, the noise program director estimated that the airport had either purchased or acoustically treated the homes of 8,547 residents living within the 1980 65 Ldn contour, effectively removing them from the noise-affected population.

Complaints about aircraft noise decreased from 264 in 1984 to 177 in 1988. An airport planner attributed the decreasing number of complaints to airlines' flying quieter aircraft and the airport's implementing the noise mitigation program.

Under FAA's Airport Improvement Program entitlement and noise set-aside provisions, Atlanta received $116 million to implement its noise compatibility program between fiscal years 1982 and 1988. Through January 1989, the airport had committed $219 million and believes an additional $180 million will be needed to complete the program by 1992. Airport officials had identified funding sources for all but $35 million of the needed funds.

Efforts to Mitigate Noise at Atlanta

Atlanta has a long history of noise mitigation activities. In consultation with FAA, noise-affected communities, and the airlines it began to develop and implement noise mitigation strategies in the early 1970s.

Early Efforts

In 1972, the airport began an informal noise study, involving airline, FAA, and local elected officials in an initial effort to identify noise corridors over the least populated areas. As a result of this effort, FAA established preferential flight tracks to reduce the noise impact on communities surrounding the airport. During the late 1970s, the airport also constructed noise barriers to reduce the impact of ground noise on surrounding communities and limited the times of day during which engine tests could be conducted.

First Formal Noise Program

In 1978, Atlanta, in conjunction with four local jurisdictions, started its first formal noise study under FAA's Airport Noise Compatibility Land Use Control program. A steering committee composed of representatives from the city of Atlanta and the three other local jurisdictions directed the study and selected the operational noise abatement measures to be implemented. The measures were analyzed by a subcommittee, which included representatives of the airport, FAA, the Air Transport Association of America—a major trade group representing scheduled airlines—Environmental Protection Agency (EPA), sponsoring local governments, and the regional planning commission. According to the airport planner, the subcommittee also considered alternate funding sources for implementing the program. As the operational measures were selected, each of the sponsoring communities developed individual land use compatibility plans, in consultation with the public, tailored to meet the communities' goals and needs. As a result of the study, the sponsors began implementing land use compatibility measures, such as property acquisition to encourage compatible land use, and Atlanta had FAA test a revised preferential departure flight track.

Part 150 Study

Atlanta's Part 150 Noise Compatibility Program grew out of its expansion efforts. In 1982, the airport prepared an environmental assessment to support construction of a fourth parallel runway and extension of an existing runway to increase airport capacity. To continue its eligibility for noise mitigation funds from the Airport Improvement Program, Atlanta used the information developed for the environmental assessment to prepare a formal Part 150 noise plan. In preparing the assessment, the airport was required to conduct a public consultation and

information program and, in doing so, consulted with the FAA, EPA, state agencies, local governments and planning commissions, and the airlines serving Atlanta. In addition, the airport met with local government officials to review and develop noise mitigation measures that met specific community needs and were appropriate for each individual neighborhood.

In developing the noise plan, the airport relied upon analysis of alternative noise mitigation measures that had been conducted between 1976 and 1983. As a result of these analyses, Atlanta considered, but did not adopt, various operational noise mitigation alternatives, including curfews, reducing general aviation activity, and rerouting traffic to other airports. The airport determined that a curfew would be illegal and could negatively affect interstate commerce, reducing general aviation activity would have no real impact on aircraft noise, and traffic could not be rerouted because of contractual and interstate commerce considerations.

The airport had made numerous physical changes, primarily to increase airport capacity, during the 10-year period ending in 1988, but made only one physical change primarily for noise control. For example, the airport considered adding crossing runways to disperse aircraft in many directions but did not consider this practical because of the high environmental, social, and economic costs. In addition, the airport considered displaced runway thresholds but determined that this would not appreciably reduce noise.

Current and Planned Mitigation Measures at Atlanta

Implementation of Atlanta's noise mitigation measures, begun in 1972, continues today. In developing its noise program, the airport's goals are as before: to reduce noise without jeopardizing safety or the operational capacity of the airport and to achieve long-term compatibility between the airport and its surrounding communities. Atlanta's current and planned measures are discussed below in terms of operational, land use, physical, and noise program management actions.

Operational

The airport has implemented four current operational noise mitigation measures. In 1972, with assistance from FAA, the airport established departure flight tracks to mitigate noise. These flight tracks were subsequently revised in 1982, after an operational test and preparation of an environmental impact statement, so that fewer people would be affected

by aircraft noise. In 1978, the airport implemented procedures prohibiting engine run-ups after 10:00 p.m., unless an emergency situation existed. The airlines have also implemented modified noise abatement departure profiles based upon standard industry procedures. Finally, after completion of the fourth parallel runway in 1984, Atlanta implemented a runway-use system designed to reduce noise and maximize operational efficiency of the airport.

Land Use

The airport's noise compatibility actions, since 1982, have focused on achieving compatible land use around the airport. The airport began buying land in 1977 and subsequently modified its program to purchase residential properties experiencing noise of 75 Ldn or greater. Through December 1988, the airport had spent $94 million to acquire 1,753 residential parcels and expects to spend an additional $36 million to acquire almost 700 more parcels. Atlanta began its soundproofing and easement purchase program in 1984, with the objective of soundproofing homes experiencing noise of 65 Ldn and greater and obtaining an easement allowing aircraft to fly over these soundproofed homes. Through January 1989, the airport had spent about $36 million on soundproofing and acquiring easements for almost 2,000 parcels and expects to spend over $200 million to soundproof and acquire easements for an additional 11,677 parcels.

The airport, either by itself or with the cooperation of surrounding communities, has implemented four additional land use compatibility measures. In 1979, the city of Atlanta and Clayton County started redeveloping airport-acquired property for commercial and industrial use. They developed roads, sewer lines, and water lines for the Mountain View area adjacent to the airport. The projects' cost of $1.2 million was funded by the Economic Development Administration, Clayton County, and the city of Atlanta. Local jurisdictions implemented two mitigation measures—compatible-use zoning and building code provisions for sound insulation of buildings. From 1986 through 1988, the nine local jurisdictions affected by airport noise incorporated the current compatible-use zoning and building code provisions into their ordinances.

According to the airport planner, the city of Atlanta included a provision for real property noise notices in its land use ordinance. A real property notice informs prospective buyers when property lies within the noise contours.

Physical

Although the airport made only one physical change specifically for noise mitigation, it made other changes to increase operational capacity that have had minor impacts on aircraft noise. In 1978, the airport installed barricades called "blast fences" to reduce off-airport noise impacts and improved them in 1988. The airport opened a new passenger terminal in September 1980, primarily to increase capacity; however, it also helped reduce noise because, according to the airport planner, it is further from adjacent neighborhoods than the old terminal. Finally, the airport constructed a fourth parallel runway to increase capacity. According to the airport planner, this may slightly relieve the noise from departing flights, since the runway will allow the two interior runways to be used primarily for departures, which are noisier than arrivals.

Noise Program Management

Atlanta has a citizens' complaint program and an informal noise-monitoring system. Although no ongoing public participation committee exists, airport staff attend community group meetings to address airport noise concerns. The airport considered but did not implement noise-related landing fees because, according to the airport planner, they may be discriminatory.

The airport implemented a complaint system in about 1982 and currently maintains a 24-hour noise complaint hotline. The airport planner's office investigates the cause of some complaints and compiles monthly and annual reports on the number of complaints.

The airport believes its informal noise-monitoring system works effectively. It has not purchased any permanent monitoring equipment, according to the airport planner, because the airport prefers to spend the available funds directly on existing noise mitigation measures, such as land acquisition and acoustical treatment. However, the planner said that FAA and the airport do some informal noise monitoring by reviewing aircraft flight tracks. The airport planner also said that she sometimes monitors overflight areas by observing FAA control tower operations and by parking near the established flight tracks and observing aircraft takeoffs and landings.

Evaluation of Noise Mitigation Measures

Although Atlanta does not regularly evaluate the effectiveness of its overall noise program, it did complete a program review in 1988. In addition, it has begun to evaluate the effectiveness of its residential soundproofing program.

As agreed to in its noise compatibility program, the airport conducted a noise program review and reported the results to FAA in March 1988. The review generally addressed (1) the appropriateness of the noise exposure maps, (2) the ability of the airport's operational controls to confine noise exposure to the designated impact areas, (3) the effectiveness of adopted land use and development controls in preventing incompatible development, and (4) the reasonableness and effectiveness of the current and future noise program in view of community and airport growth rates.

The review found that the noise map currently in use overstates the area experiencing noise levels of 65 Ldn or greater. This occurred because the map was based on aircraft operation forecasts that did not materialize—i.e., fewer air carrier and nighttime operations took place than were forecast. Because of the cost of developing new maps and the insignificant changes in the area experiencing noise of 65 Ldn or greater, Atlanta proposed to continue using the existing map to implement its noise program. FAA concurred with the airport's proposal because the airport had already made a commitment to the people living within the noise contours established in the map.

In reporting on the other review objectives, Atlanta discussed ongoing FAA and Air Transport Association monitoring of airline adherence to noise abatement flight tracks—an operational measure—but did not evaluate or report the extent to which airlines adhere to these procedures. Regarding land use controls, the report stated that surrounding local governments had restricted or discouraged future incompatible residential land use and had appropriately zoned property that had been purchased and cleared by the airport. Responding to the final objective, the airport reported that prior to implementation, each program measure—other than property acquisition—had been formally reviewed, and those measures that were not reasonable were revised or eliminated.

Atlanta is also beginning to evaluate the effectiveness of its soundproofing program, according to airport officials. They recently began issuing questionnaires to soundproofing program participants, to determine the impact of the soundproofing, and working with FAA to develop sampling procedures for determining the actual noise reduction achieved by the soundproofing.

Status of Part 150 Program at Atlanta

Atlanta began developing its Part 150 noise compatibility program in 1982 and initially submitted the noise exposure map in November 1982. After receiving FAA's comments, the airport revised the map and submitted it and the noise compatibility program for FAA approval in April 1984. FAA formally approved the noise compatibility program in April 1985, almost a year after it had been submitted. The airport subsequently developed two noise program revisions, which FAA approved after 9 months and 8 months respectively.

FAA's Role

FAA's Atlanta Airports District Office advised and assisted the airport while it was developing the noise exposure map and compatibility program and reviewed those documents after they were completed. In addition, FAA's air traffic control tower tested and implemented revised departure route procedures. The FAA tower also periodically monitors aircraft adherence to the arrival and departure tracks and assists the city of Atlanta's aviation department in resolving particular noise complaints.

The guidance provided by FAA during noise program development has been clear, consistent, and sufficiently detailed, according to the airport planner. She also said that FAA raised no substantive objections or concerns regarding the proposed mitigation measures in Atlanta's plan. She was surprised, however, that FAA spent almost 2 years determining that the noise exposure map complied with Part 150 program requirements, although this delay did not adversely affect the airport's progress in implementing the program. No adverse effect occurred because the airport's noise program was eligible for funding under the "grandfather" provisions of the Aviation Safety and Noise Abatement Act of 1979 and the airport was able to continue receiving federal funding while FAA reviewed its Part 150 program.

According to the Atlanta noise program director, the Part 150 review process would be more efficient if FAA headquarters would delegate authority to approve program changes to the FAA region or the airport's district office. He cited Atlanta's request of FAA to permit it to add single-family rental units, churches, and private schools to its easement and acoustical treatment program as an example of where this delegation would have benefitted the program. The airport had to obtain approval for the additions from FAA headquarters, which took almost 8 months. However, according to the noise program director, FAA's Airports District Office could have approved the noise compatibility plan revision within a week. FAA headquarters officials acknowledge that

delays occur in approving programs, and they plan to issue a study in October 1989 that will address ways to streamline the process.

Baltimore/Washington International Airport Noise Mitigation Efforts

Baltimore Washington International Airport (Baltimore) has had a noise abatement plan and public participation process since 1976. The plan and process emanated from the Environmental Noise Act, enacted by Maryland in 1974, enabling the regulation and control of aviation noise effects through land use restrictions and managing airport development. Resulting state regulations require periodic noise abatement plan and airport noise zone updates. Because of an increased emphasis on mitigating noise, in 1988 Baltimore's noise abatement plan was expanded to include noise mitigation measures, such as land acquisition and soundproofing. In addition, Baltimore officials developed a Part 150 program to further mitigate adverse noise effects on surrounding communities and submitted the program to FAA in January 1989.

Background

Baltimore's 3,300-acre facility was constructed in the late 1940s and began operations in 1950. Maryland purchased the facility, the state's only major air carrier airport, from the city of Baltimore in 1972. Baltimore is operated by the Maryland State Aviation Administration (Aviation Administration). The airport is located in an area of mixed land use, which is characterized by older established communities and a fast growing industrial and office complex. There are some less developed areas that are wooded or open, or are just beginning to experience suburban development.

Annual aircraft operations have increased one-third, between 1979 and 1987—from 220,227 in 1979 to 293,722 in 1987. More importantly, air carrier jet operations have more than doubled from 68,069 in 1979 to 145,891 in 1987. According to airport officials, the noise resulting from this increased jet traffic has significantly enlarged the 65 Ldn noise contour and thus, to some unknown degree, increased the number of homes and individuals affected by noise. The Aviation Administration was unable to determine the increase in the number of individuals and facilities affected within the 65 Ldn contour until recently because reliable data had not been collected. However, as of 1987, approximately 14,200 individuals and 5,200 homes are within the 65 Ldn noise contour. In addition, the number of noise complaints has significantly increased from 38 in 1977 to 1,720 in 1988. The increase is attributed to a major hubbing operation that began in 1983 and to a greater public awareness of how to complain. Since 1976, Baltimore has operated a telephone hotline for aircraft noise complaints.

Environmental Noise Act of 1974

Maryland enacted the Environmental Noise Act in 1974, which was one of the nation's earliest and most comprehensive expressions of how localities can use their governmental powers to regulate and control the problems associated with environmental noise. The 1974 act has, in effect, required that noise effects be addressed hand in hand with plans for airport expansion. The act requires the state to achieve control of aircraft and airport noise through two approaches: (1) controlling airport development and operations and (2) initiating land use restrictions around airports. Airport development is restricted to those purposes that are compatible with the noise environment, and the law encourages converting incompatible land to compatible land.

The 1974 act and related regulations have encouraged the close working relationship between the Aviation Administration and local planning offices to ensure that aircraft noise affects as few entities as possible. An airport-zoning district, covering a 4-mile radius, was established; and within this zone, the Aviation Administration and county officials are required to work closely on zoning regulations. In addition to the zoning district, an Airport Noise Zone was established and is defined as all land located within the 65 Ldn noise contour. All construction or modification to a structure or land use is strictly regulated within this noise zone through permits obtained from the Aviation Administration.

Efforts to Mitigate Noise at Baltimore

Baltimore implemented its first noise abatement plan in 1976 and updated it in 1982 and 1988. According to airport officials, the process to review, approve, and implement each noise mitigation measure during the noise abatement plan's updates has generally not varied. For example, use of consultants to conduct necessary technical analyses and broad public involvement have been part of the process for over 10 years.

1987/1988 Update of Noise Abatement Plan

Development of Baltimore's current noise abatement plan culminated a 16-month study effort, beginning in January 1987. As part of the study, a consulting firm conducted the technical analysis required to update the noise contour map and assess the implications of various noise abatement procedures. The study evaluated noise abatement measures in two phases dealing with, first, operational procedures at the airport as well as those used by the FAA in air traffic control and, second, a wide range of policy measures that could restrict use of the airport by noisy aircraft. The Aviation Administration selected the measures to be implemented on the basis of the consultant's analysis and public input.

Broad public involvement helped determine the airport's overall noise program. The Aviation Administration organized the Ad Hoc Advisory Committee to ensure public awareness and input at each step of the study process, as required by the 1974 act. The committee consisted of over 28 community associations, aviation industry groups, state and local government agencies, the Aviation Administration, and FAA. The committee met 11 times during the 16 months to review the consultant's technical work, discuss issues, and provide input. Public involvement was further effected through three public meetings held during the study and through five newsletters published and distributed by the Aviation Administration. A concluding formal public hearing in August 1988 resulted in seven significant changes to the noise abatement plan and a noise contour map as originally proposed.

The final study report documents the results of the Aviation Administration's study of the noise abatement plan and airport noise zone. Baltimore submitted the report to FAA in January 1989 for review and approval under the Part 150 program.

Current and Planned Mitigation Measures at Baltimore

Baltimore's current overall noise program consists of measures implemented as early as 1976 as well as more recent measures and is based upon operational changes, such as a preferential runway system, and land use measures, such as land acquisition. In addition the airport's overall noise program has a program management component that includes a noise-monitoring system and a citizen complaint mechanism. The noise mitigation measures implemented at Baltimore are discussed below in terms of operational, land use, physical, and noise management actions.

Operational

Baltimore currently has several operational measures to reduce the impact of aircraft noise. These include a preferential runway system, restrictions on ground noise, modified approach and departure procedures, and power and flap management. The airport has also raised the altitude of arriving aircraft to lessen the noise effects in some communities. In addition, several new flight routes have been identified for possible implementation.

The Aviation Administration first implemented a preferential runway system and restrictions on ground noise as part of its 1976 noise abatement plan. The purpose of the preferential runway system was to balance runway use. However, in 1987 the airport, with FAA concurrence,

established a preferential runway use system as a noise mitigation measure. Ground noise restrictions included a limitation on engine testing, which restricted the location, duration, and time of engine tests. The 1988 noise plan further required that nighttime emergency tests receive prior approval from the airport operations manager. In addition, procedures established in 1987 prohibited using an aircraft's engines to move the plane away from the gate if it would result in noise over a specified level.

The Aviation Administration first implemented noise abatement aircraft approach and departure procedures in 1976. The 1976 plan included a noise abatement takeoff procedure that requires aircraft to climb as quickly as possible, consistent with safety and aircraft performance capabilities. In 1987, Baltimore formally adopted FAA's noise abatement departure procedure. This procedure consists of a stepped climb, which is quieter and more fuel efficient. The airport's recommended approach procedures have remained relatively constant since 1976.

During the recent update of the noise abatement plan, the Aviation Administration identified and tested several new flight routes in cooperation with the FAA tower. In the spring of 1988, the Aviation Administration and FAA tested and evaluated the new flight tracks for their impacts on safety, capacity, and noise. Safety and reduction in the noise-affected population were the major criteria for implementation. As of August 1989, FAA had not approved these new flight tracks.

Land Use

Baltimore's earliest land use measures consisted of noise compatibility zoning restrictions as required by the 1974 act. Land use measures were expanded in 1985 with the establishment of a land acquisition program and in 1988 with the soundproofing and purchase assurance programs.

The 1974 act and related regulations establishes two levels of zoning restrictions to mitigate airport noise impacts. First, an airport zoning district was established, which covers a 4-mile radius from the airport. Within this district, the Aviation Administration works closely with the county to ensure compatible land use through restrictive zoning. Second, an Airport Noise Zone was established and is defined as land within the 65 Ldn noise contour. Within this zone, all changes to existing structures and land uses must be approved by the Aviation Administration through a permit application procedure. If, during the permitting process, a permit is denied by the Aviation Administration, the applicant may appeal to the Board of Airport Zoning Appeals for a variance from

established noise regulations. The Board may grant a variance, requiring compliance with conditions designed to protect future occupants. The Board was created in 1974 by the Maryland General Assembly and is composed of 10 citizen members appointed by the governor.

The Aviation Administration, in 1985, began a voluntary land acquisition program to acquire homes within the 75 Ldn noise contour. As of January 1989, 34 of 59 eligible properties had been purchased for approximately $6 million. Since January 1989, funding has been approved to acquire an additional 48 properties for approximately $9.4 million. The majority of the funding was provided by FAA's Airport Improvement Program. Baltimore's pending Part 150 program plans to extend the land acquisition program to include 238 residential properties within the 70 Ldn or greater noise contour. If approved, the total estimated program cost to purchase the eligible properties is $50 million.

In 1987, Baltimore began a voluntary program of soundproofing homes and a purchase assurance program for homeowners within the 65 Ldn noise contour. In 1988, 17 houses were soundproofed at an approximate cost of $400,000. An additional 40 houses are planned to undergo soundproofing in 1989. In addition, Baltimore plans to soundproof two of five schools within the 75 Ldn contour at an approximate cost of $5 million. The purchase assurance program assists homeowners by providing financial payments guaranteeing full resale values for their homes. As of January 1989, four homeowners had participated for approximately $39,000 in state funding. The Part 150 program, once approved, plans to expand both programs to include 785 additional homes within the 65 Ldn noise contour. If all eligible homeowners choose to participate, estimated costs of both programs are approximately $15 million. Officials estimate the programs will take 6 to 7 years to complete, depending on state and federal fund availability and homeowner participation.

Physical

Since 1981, numerous physical modifications have been made at the airport, of which one has been for noise control. For example, Baltimore has implemented several runway improvement projects and plans to construct an additional runway to increase the airport's capacity. The future development of a tree barrier will be the only physical change at Baltimore strictly for noise reduction.

The tree barrier is a result of a barrier feasibility study as well as a result of some public and political concerns. The Aviation Administration, during its 1985 master plan study, requested a consultant to determine the feasibility of noise barriers to help reduce the effects of ground noise on adjacent communities. One location was identified as appropriate for an earthen barrier. However, during public hearings some concerns, such as the aesthetics of the barrier, were raised by some community members and local politicians. As a result, a compromise solution consisting of the tree buffer was accepted even though it will not be as effective as the earthen barrier.

Noise Program Management

Along with public hearings during updates of the noise abatement plan, Baltimore's current noise monitoring system and noise complaint hotline aid in its program management. In addition, the newly established Environmental Committee will assist the Aviation Administration in monitoring noise concerns.

Baltimore's computerized airport noise monitoring system, established in October 1986, helps address, among other things, noise complaints received through Baltimore's 24-hour noise complaint hotline, which was established in 1976. With the noise monitoring system the Aviation Administration is able to pinpoint the nature, time, and duration of aircraft noise in surrounding areas and to develop land use and noise contour maps. With these data on aircraft noise, Baltimore noise analysts are able to investigate the cause of noise complaints. The system will also be used to help the Aviation Administration evaluate the effectiveness of its overall noise abatement program. The results of the monitoring, noise complaint, and airport operations data are compiled and distributed to the public on a quarterly basis.

A permanent Environmental Committee was established by the Aviation Administration in February 1989. Committee membership is composed of representatives from local communities, state and local agencies, airport users, FAA, and Aviation Administration officials. The Committee will meet on a quarterly basis to assist the Aviation Administration both in monitoring airport activities and noise abatement concerns and in reviewing progress toward meeting the Aviation Administration's noise abatement goals.

Evaluation of Noise Mitigation Measures

Baltimore's overall noise mitigation program will undergo an annual general effectiveness review to assess the progress made in meeting the airport's goal of limiting noise levels, by 1993, to those that existed in 1987. The evaluation process will include an assessment of changes in noise complaints and noise levels measured through Baltimore's noise-monitoring system. In addition, the airport has an ongoing program to monitor single event noise levels to determine the effectiveness of the arrival/departure procedures and flight track changes in regard to aircraft noise over the most densely populated areas. This evaluation process relies heavily on the noise-monitoring system, portable noise monitoring, and data collected during the annual review process to include assessments of flight track data. The Aviation Administration will monitor progress toward reaching the proposed noise reduction goal; and if necessary, the Aviation Administration will consider the need for mandatory use restrictions, such as a ban on nighttime flights and the increased use of Stage III aircraft.

Status of Pending Part 150 Program at Baltimore

The availability of federal noise mitigation funds to continue and expand noise program efforts drove the Aviation Administration's decision to develop a Part 150 program. Initially, the Aviation Administration officials believed that participating in FAA's Part 150 program would not be beneficial for a number of reasons, including questions about the continuing availability of federal funds. In developing its Part 150 program, Baltimore received adequate guidance from the FAA, although officials cited the need for additional actual participation by FAA during the development.

For several reasons, the Aviation Administration initially chose not to participate in the Part 150 program. These reasons included, among others, the uncertainty surrounding a new federal program, questions regarding future funding availability and the funding prioritization process, and the additional constraints that the federal government could place on the airport. However, despite these concerns, in the spring of 1988, Baltimore decided to participate, primarily because of funding needs to continue implementing various noise mitigation measures. In addition, Baltimore officials believed that little effort would be needed to convert the current overall noise abatement program into a Part 150 program because of the similarity between the two programs.

The Aviation Administration did not request Part 150 planning funding for the development of its Part 150 program because of the timing of its

decision and FAA's grant process. The Aviation Administration's development costs for both programs were approaching $1 million, as of January 1989. Baltimore's Part 150 noise compatibility plan and noise exposure map were submitted to FAA for review in January 1989. However, FAA did not begin the review of the noise compatibility plan or the noise exposure map until August 1989. According to Aviation Administration officials, FAA's lengthy review process, due to inadequate staffing in FAA's Eastern Region, is a serious concern.

FAA's Role

Airport officials believe that FAA provided adequate guidance during the development of their Part 150 program. However, the Aviation Administration's experience in noise planning and the experienced consultant used to conduct technical aspects of program development resulted in the need for less detailed guidance from FAA. FAA's written guidance provided included the Part 150 regulations and noise exposure map and noise compatibility plan checklists. FAA also provided guidance during the Ad Hoc Committee meetings. The Aviation Administration officials believe, however, that FAA should become more actively involved in program development. In response to FAA's request for public comment on the Part 150 program and plans to issue a report on the program before the end of the fiscal year, the Aviation Administration suggested that FAA become an active participant throughout the entire Part 150 process instead of on an as-needed basis. On the basis of these and other comments, FAA plans to issue a report in October 1989 addressing ways to improve the part 150 program.

Chicago O'Hare International Airport Noise Mitigation Efforts

Aircraft noise is a significant and controversial issue at Chicago O'Hare International Airport (Chicago). Although the number of people significantly affected by aircraft noise has fallen by one-third over the last 20 years, over 200,000 people still experience noise levels of 65 Ldn or greater. The city of Chicago's policy is to mitigate aircraft noise without delaying aircraft operations, reducing airport capacity, or harming the region's economy. Since 1984, however, implementing this policy has been difficult because the O'Hare Advisory Committee—the airport's principal community advisory group—has not been able to agree on which, if any, additional noise mitigation measures should be adopted. The city is currently applying to FAA's Airport Improvement Program for grant money with which to lessen the impact of aircraft noise by soundproofing schools experiencing noise levels of 65 Ldn or greater.

Background

The airport is owned and operated by the city of Chicago through the city's Department of Aviation. Chicago is one of the busiest airports in the world, ranking second in annual operations in 1987 among airports in the United States. It experienced 797,000 operations in 1987, an increase of 8 percent over 1979.

Although two growing counties contain numerous suburban communities that surround the airport, aircraft noise is affecting fewer people. The population of city wards and 28 suburbs affected by Chicago noise grew by over 60 percent from 1960 to 1980—from 485,000 to 776,000. However, the size of this population affected by aircraft noise has since diminished. The city estimated that for 1979 and 1988 the population falling within the 65 Ldn contour was approximately 312,920 and 210,000, respectively. Airport officials attribute this decline to quieter aircraft and to more precise measurements of aircraft noise.

In 1974, the state of Illinois and surrounding communities filed a lawsuit against FAA and the city of Chicago seeking relief from noise and air pollution that had resulted from increased airport activity. The lawsuit was settled through a 1982 consent decree in which the city agreed to establish a noise mitigation management process and FAA agreed to prepare an environmental impact statement that imposed a wide range of noise mitigation measures, such as school soundproofing and constructing noise barriers, on the airport.

Although the number of those affected has fallen, complaints have increased. In 1983, the city received 2,229 aircraft noise complaints, the level reached 18,000 in 1984, and it has since fluctuated between 10,500

and 15,500. Airport officials attribute the complaint increase to better public awareness of the complaint phone line and the full-time staff available to receive complaints.

Under FAA's Airport Improvement Program noise set-aside provisions, the city received $9.3 million for school soundproofing between fiscal years 1982 and 1988 and another $776,000 to conduct its Part 150 study, which is still in process. Because the city has not completed its noise measure analysis under the Part 150 program and has not formulated its noise program, city officials were unable to discuss specific funding needs.

Efforts to Mitigate Noise at Chicago

Over the years, three major entities have formed the nucleus of effort to mitigate aircraft noise at the airport. These entities are (1) FAA, (2) the city-established Technical Working Group, and (3) the O'Hare Advisory Committee. Each has individual goals and has approached the noise issue uniquely.

FAA's Early Efforts

Because many of Chicago's noise mitigation measures relate to the air traffic control operations of the airport, FAA has been primarily responsible for implementing them. For example, in 1970, FAA's air traffic control tower implemented Chicago's first noise mitigation measures, a nighttime preferential runway-use system and preferential flight tracks. The measures were designed to minimize aircraft noise affecting residences surrounding the airport. FAA's initial measures, since modified, are still in effect.

In addition, in 1984, at the request of the O'Hare Advisory Committee, FAA designed and tested a revised nighttime preferential runway-use system and flight tracks. Although the test results were favorable, a still-pending lawsuit prevented FAA from implementing the revisions.

Technical Working Group Efforts

The city, in 1981, formed the Technical Working Group to recommend operational noise abatement and land use control measures to be incorporated into the airport's future development plans. The working group included representatives from the city, FAA, the Air Transport Association, and the Suburban O'Hare Commission—a coalition of local governments formed in 1981 to address noise from the airport.

O'Hare Advisory Committee Efforts

The O'Hare Advisory Committee was established, in 1982, as a forum to discuss environmental planning and review aspects of the airport's operations. The city and FAA must consider all noise abatement procedures proposed by the Advisory Committee and explain their decisions on the proposed procedures to the Advisory Committee. The Committee consists of city and state officials, representatives of the Suburban O'Hare Commission, surrounding communities and counties, an area-wide planning organization, the Air Transport Association, business interests, and FAA.

In 1984, FAA also designated the Advisory Committee as the primary vehicle for community involvement in a study to develop a Part 150 program to reduce the land use around the airport that is not compatible with aircraft noise. FAA required the Part 150 study as a condition of approving Chicago's expansion plans. As of July 1989, the study was still ongoing.

Later Efforts

FAA's 1984 environmental impact statement, resulting from the 1982 court order, addressed the expansion of Chicago and what could be done to mitigate the airport's environmental effects. As a result, FAA committed the airport to construct a noise barrier, soundproof 26 schools, establish procedures to monitor adherence to the noise abatement flight tracks, and acquire land within the 80 Ldn contour. Prior to FAA's action, the city had established a noise-monitoring system, begun distributing annual noise contour maps, created a noise complaint hotline, and formed an airport-public advisory group.

Responding to FAA's actions, the Suburban O'Hare Commission filed suit in December 1984, alleging that the environmental impact statement underlying FAA's record of decision was deficient and, therefore, that Chicago should not be allowed to implement additional airport development projects until the matter was decided in court. In March 1986, the U.S. Court of Appeals refused to reverse FAA's decision to approve the airport layout plan, thus denying the Commission's suit and allowing development at Chicago to continue.

The airport also considered operational noise abatement measures, such as curfews, a cap on number of daily operations, and limiting the use of reverse thrust. However, the airport determined that curfews and caps had severe economic effects and could be an unreasonable burden on interstate commerce. Therefore, these measures were not implemented.

Minimizing use of reverse thrust was not implemented because of safety concerns from FAA.

In addition, Chicago considered other physical measures, such as new runway construction or displaced runway thresholds, during the development planning process but determined them to be either illegal under the terms of the 1982 consent decree or detrimental from an operational standpoint.

Current and Planned Mitigation Measures at Chicago

It is the city's policy to use noise mitigation measures at Chicago that do not increase flight delays, decrease flight capacity, or adversely affect the region's economy. The airport's current and planned measures are discussed below in terms of operational, land use, physical, and noise program management actions.

Operational

FAA's 1970 traffic control order at Chicago initially implemented several noise measures still basically in effect. They included a preferential runway-use system to concentrate the impact of aircraft noise during the nighttime hours and a requirement that nighttime engine runups be conducted at specific locations. The order was subsequently modified to establish a rotational runway-use system that spread aircraft-generated noise during day and evening hours. The order was last modified in 1981. These 1981 procedures are monitored by Chicago officials who require an FAA explanation for any procedural deviation not supported by weather or other operational conditions.

FAA's order also restricted the location of nighttime engine tests. In addition, in 1982 the airport modified engine test procedures requiring approval of all engine tests conducted during nighttime hours. Chicago monitors airline adherence to the nighttime engine test procedures and requires serious violators to appear before the Advisory Committee to explain their actions. There has been one violator brought before the Commission since 1984.

Finally, aircraft use noise abatement power and flap management procedures when departing. As required by FAA's environmental impact statement, the city, in fall 1988, implemented a system to monitor aircraft use of the procedure.

Land Use

As a result of FAA's environmental impact statement, Chicago implemented a program to soundproof 26 schools within the 70 Ldn noise contour. The estimated cost to soundproof these schools is approximately $29 million, with FAA funding 80 percent of the actual costs. Through September 1988, contracts for soundproofing 11 schools had been awarded for $11.4 million with FAA's share comprising $9.1 million. FAA, through May 1989, had awarded grants to soundproof an additional seven schools to ensure desired interior noise levels.

FAA's environmental impact statement also committed the city to purchasing all residences within the 80 Ldn contour if they are voluntarily tendered by the owner and if the local municipality agrees to establish and maintain compatible land use for the property. As of May 1989, no property had met both of these conditions, and therefore none had been purchased under this program. According to Chicago officials, a broader land acquisition program had been discussed, but representatives of the surrounding communities would not accept it because the communities did not want the city of Chicago owning land within their boundaries.

Other land use measures, such as compatible-use zoning or building codes requiring soundproofing of all structures within noise-affected areas, are under the control of local municipalities; and the airport plans to consider them further in its Part 150 study. The surrounding communities have generally not adopted land use or zoning regulations or building codes that recognize the effect of noise generated by the airport.

Physical

Physical changes at Chicago have been considered, but only one—building a noise berm—has been implemented to mitigate noise. As a result of FAA approval of the airport layout plan, the city constructed the berm at a cost of $1 million in airport funds. Although the measure does not involve construction, the city also requires that nighttime engine tests be done in specific locations.

Noise Program Management

Under the 1982 consent decree, the city agreed to implement a mobile noise-monitoring program and a citizen complaint system and to continue a community participation committee to develop and analyze noise mitigation measures as well as oversee the noise-monitoring and complaint systems. The noise-monitoring system measures the noise effect on specific locations as well as noise levels in soundproofed schools. The

complaint hotline operates 24 hours a day, with complaints recorded, summarized, and reported to the Advisory Committee monthly. In addition, nighttime noise complaints may result in the city asking an airline to explain operational variances. In 1983, the city spent $57,000 for noise-monitoring equipment and now spends, according to airport representatives, over $500,000 annually to support the noise-monitoring, complaint, and community participation programs.

Evaluation of Noise Mitigation Measures

Other than measuring interior noise in soundproofed schools, the city has not formally evaluated noise mitigation measures that are in place. However, it is currently examining the results of existing noise measures, such as the restriction of engine tests and the preferential runway-use system, as part of the airport's analyses of alternative noise mitigation measures to be included in its Part 150 program. According to the airport's Part 150 study plan, the airport plans to annually monitor and update its noise compatibility program by reviewing the effectiveness and accuracy of the airport noise compatibility program components, the noise exposure map, and operational and land use controls.

In addition, the Advisory Committee, assisted by a consultant, began evaluating noise mitigation measures in the summer of 1988. Among the measures being evaluated are revising engine test procedures, restricting or reducing operations, changing runway use and flight tracks, enforcement mechanisms, and installing a permanent noise-monitoring system. Land use measures being considered include establishing a statewide airport land use law, encouraging community modification of zoning regulations and building codes, purchasing land to prevent or reduce incompatible land use, and insulating noise-sensitive facilities.

Status of Part 150 Program at Chicago

Although FAA's 1984 environmental impact statement committed the city to developing a Part 150 program, progress to date has been slow and marked by controversy. In March 1989, city officials estimated it would be least 1 year and possibly 2 before the noise compatibility program is submitted to FAA for approval. The O'Hare Advisory Committee had difficulty agreeing on the goals and objectives of the Part 150 program or when to submit the noise exposure map. Airport and community representatives we contacted stated that FAA could have provided more specific guidance to the committee and the airport regarding development of the program.

Controversy over who would control the Part 150 process delayed establishing the program's goals and objectives until November 1987. The city was ready to submit its noise exposure map to FAA in January 1988; however, the Suburban O'Hare Commission believed the map would reduce property values and wanted publication delayed until operational noise-mitigation measures were developed and future noise contours could be developed. The city submitted the map in August 1988, the latest date that FAA would accept it without revisions, because it believed it needed to demonstrate compliance with the 1982 court order.

FAA's Role

Airport officials believe that FAA has provided sufficient guidance on the safety of proposed noise abatement measures but stated that FAA should be providing more specific guidance on acceptable capacity constraints or operational limitations that can be placed upon the airport. Officials are also concerned about the availability of federal funding necessary to implement the noise program once it is developed.

The FAA provided comments on the noise exposure map to the city by the end of 1988. The city viewed few of FAA's comments as substantive, believing that the comments were generated under an assumption that a lawsuit may be filed after FAA acceptance of the map. The city responded to FAA's comments in July 1989.

According to airport officials, FAA's Part 150 program guidance was not sufficiently clear and detailed to efficiently conduct the noise study. They commented that FAA's representative provided adequate guidance on the acceptability of proposed noise control measures from a safety standpoint but did not do so for measures that could restrict interstate commerce. The officials also stated that FAA needs to develop and provide clear criteria for airports to use in assessing the feasibility and acceptability of noise mitigation measures that could restrict interstate commerce. FAA's representative on the Advisory Committee agreed that FAA does not have specific guidance on this matter but believed such guidance was unnecessary, since policies relating to interstate commerce are addressed in FAA's 1976 aviation noise policy.

Airport officials are concerned about the availability of future federal funding to implement the noise compatibility program once FAA approves it. They believe that the Part 150 program raises community expectations that something will be done about noise immediately, but lack of funds may prevent this prompt action.

Los Angeles International Airport Noise Mitigation Efforts

Aircraft noise has been a problem at Los Angeles International Airport (Los Angeles) since the early 1960s. Since then, the airport has taken many noise mitigation actions and plans to implement additional measures. As a result, the number of residences affected by noise has decreased by 69 percent since 1970. Although airport officials are concerned about losing capacity because of noise mitigation measures, they believe that their policy not to restrict access to the airport or its use, but to reduce noise with other kinds of actions, has provided an effective balance between noise and capacity concerns.

Background

Los Angeles is owned by the city of Los Angeles, governed by the Board of Airport Commissioners, and operated by the city's Department of Airports. Built in 1928, the airport occupies a 3,500-acre coastal site within the city limits. In fiscal year 1987, it experienced over 655,000 operations, an increase of 24 percent over fiscal year 1978.

The population surrounding the airport has grown as airport operations have increased, but the number of people affected by noise has decreased. The population in communities surrounding the airport increased from 2.7 million in 1960 to 3.2 million in 1980—an increase of approximately 20 percent. However, between 1982 and 1988 the noise-affected population—defined by the 65 CNEL (community noise equivalent level) contour[1] —decreased 19 percent, from 92,300 to 74,500. Airport officials believe this number will decline further because of the airlines' increased use of quieter aircraft. Complaints, on the other hand, have increased. In 1982, the airport received 332 complaints, but by the end of 1988, annual complaints had risen to 2,677. Airport officials attribute the increase to noise from helicopter operations and aircraft violating a noise abatement flight procedure.

California state law has set noise standards and requires that (1) county airport land use commissions adopt comprehensive land use compatibility plans for areas around each public use airport within its jurisdiction, (2) no residential communities be within the 65 CNEL contour by January 1, 1986, and (3) airports submit quarterly noise reports and noise exposure maps. A comprehensive land use plan is currently being developed for the airport, and the state has granted the airport a variance from the

[1]Under state law, California airports must calculate noise-affected populations using the community noise equivalent level (CNEL) measure system. This measure differs from the Ldn measure used by the other airports because CNEL assigns a 3-decibel penalty to evening noise, 7:00 p.m. to 10:00 p.m., and a 10-decibel penalty to nighttime noise between 10:00 p.m. and 7:00 a.m.

restriction on residential communities within the 65 CNEL contour because the airport has made genuine efforts to achieve the goal.

Airport noise has been the subject of numerous lawsuits at the airport. For example, before development of the Part 150 noise compatibility study, school districts sued the city seeking relief from the airport's noise. Under the terms of the lawsuit settlement, school districts received about $21 million in damages from the airport and were obligated to use the funds for soundproofing their schools. In return, Los Angeles received easements allowing overflights of the noise-affected schools.

Under the Airport Improvement Program noise set-aside provisions, Los Angeles received $21.3 million for noise mitigation projects in fiscal years 1982 through 1988 and had previously received $500,000 to conduct its noise study. Past and future estimated costs to complete all approved noise compatibility program projects exceed $383 million. In 1987, the airport established a program to provide surrounding communities up to $5 million annually to meet the matching fund requirements of Airport Improvement Program noise mitigation grants.

Efforts to Mitigate Noise at Los Angeles

The city of Los Angeles and FAA have been involved in reducing aircraft noise since 1959 when the airport first began to regulate jet engine noise in airline maintenance areas. Since 1965, to reduce the off-airport noise impacts of new runways, the airport has acquired 632 acres of residential property on its northern boundary. Beginning in the early 1970s, the airport and FAA considered a number of operational measures to reduce noise impacts. However, not all were implemented for various reasons. For example, nighttime use restrictions were not implemented by the airport because of the undue burden placed upon interstate commerce.

Because aircraft noise continued to be a concern among the communities that surrounded the airport in the late 1970s, the airport conducted an airport noise control and land use compatibility study between 1980 and 1984. The study proposed measures to achieve compatibility between the airport and surrounding communities through airport operations, construction, land use adjustments, and enhanced noise program management. The study team included representatives of the airport, Los Angeles County, FAA, pilot and transport associations, state and local government agencies and associations, and local communities. These participants were organized into a steering committee and technical committees, which met to discuss and analyze the relevant study issues.

All steering committee meetings were advertised in local newspapers, and the public was invited to attend. In addition, the steering committee obtained public assistance in defining noise problems and prioritizing noise control needs.

In 1986, the airport reached its planned air passenger volume of 40 million annual passengers. As a result, the airport studied the environmental and socioeconomic effects of increasing passenger service levels to 65 million annual passengers by the year 2000. During the study, the airport further analyzed some noise mitigation measures proposed in the noise compatibility program and identified additional actions that could be taken to reduce noise impacts. The February 1988 draft report concluded that even though the number of future operations increased, noise-affected dwelling units would continue to decline because of the increased use of newer, quieter aircraft. In November 1988, the Los Angeles City Planning Department recommended deferring further consideration of the report until it could properly address the capacity control issues.

Current and Planned Mitigation Measures at Los Angeles

The airport's noise mitigation program has evolved over the last 25 years as a result of the airport's desire to expand operations, community concerns, and state legislation. A number of noise mitigation measures have been considered for implementation at Los Angeles. Many of the measures, such as restrictions on engine tests and use of preferential runways, still remain in effect. In all, Los Angeles implemented a wide range of operational, land use, physical, and noise program management measures.

Operational

FAA and the airport have implemented a series of operational noise reduction measures in the past 20 years. For example, in 1970, the airport implemented gate hold procedures, under which engine starts and departures from gate positions are directed by the FAA control tower. A 1973, a nighttime preferential runway-use system to reduce noise in northern and southern communities and nighttime preferential flight tracks that shift noise over the ocean and away from residential areas were implemented. In 1987, FAA implemented additional instrument procedures that result in reducing aircraft overflights of residential areas. Finally, in January 1989, the airport proposed greater use of an inner runway that would remove 1,145 people from within the 65 CNEL and potentially save $2.7 million in residential soundproofing costs.

Since 1970, Los Angeles has prohibited nonemergency nighttime tests of mounted aircraft engines. In 1981, the airport installed a closed-circuit noise-monitoring system to detect unauthorized nighttime engine tests. Other measures the airport has taken to reduce noise include

- requiring since June 1984 that aircraft using the terminal closest to the city of El Segundo be towed between the airfield and the terminal,
- installing during the 1980s fixed power and air conditioning units costing approximately $5 million to reduce the need for aircraft to run their engines or auxiliary power units while at gates, and
- raising in July 1988 the altitude on helicopter routes by 500 feet.

Land Use

Los Angeles has acquired land and easements allowing aircraft overflights and has soundproofed schools and residences in surrounding communities. In addition, although it has no control over compatible-use zoning, the airport supports community projects to increase airport-compatible land use.

Since 1965, the airport spent $144.3 million to remove incompatible land uses surrounding the airport by acquiring 2,834 residences, relocating about 7,000 residents, and removing or relocating the vacant structures. FAA provided $115 million for these actions. The airport did not acquire some adjacent property because it was zoned for compatible use at the time. However, according to airport officials, in one case the municipality rezoned the property for noncompatible land uses. This allowed construction of a 444-unit apartment building adjacent to the edge of a runway.

The airport spent $30 million to acquire easements allowing aircraft overflights. For compensation of $21 million, school districts settled a lawsuit by agreeing to provide overflight easements and to soundproof noise-affected schools. In addition, the airport spent $5 million to acquire easements from private property owners.

The airport has begun implementing its program to soundproof residences experiencing noise levels within the 65 CNEL. The airport's consultant estimated $184 million would be needed to soundproof approximately 29,000 residential units experiencing these noise levels. As of March 1989, the airport has initiated or completed soundproofing 100 residences within the 70 CNEL at a total cost of $1.8 million—FAA provided $1.5 million.

Under California laws related to airport noise, the Los Angeles County Regional Planning Department is responsible for developing an Airport Land Use Compatibility Plan, to foster compatible land use patterns around the airport. Such a plan has not yet been developed. However, the airport is working with responsible jurisdictions to achieve compatible-use zoning for acquired properties and other noise-affected areas.

Physical

Physical changes at Los Angeles have been considered, but only one—building a noise berm north of the airport—has been implemented primarily to mitigate noise. The airport paid $410,000 to construct the 1,500-foot berm, which was completed in 1979. In addition, FAA appropriated $40,000 to the city of El Segundo to study the feasibility of erecting noise attenuation barriers, but no additional barriers have been built. However, high-speed taxiways constructed primarily to increase capacity and reduce air pollution have incidentally resulted in some noise reduction.

Noise Program Management

The airport has established a noise-monitoring system, a community complaint mechanism, and a community participation program. For the 2-year period 1988-89, the airport has budgeted $456,000 to administer and support its noise abatement and program management activities.

The airport has had a state-certified noise-monitoring system since May 1976. Under its Part 150 noise compatibility plan, the airport is installing a computer-based monitoring system that will use FAA flight control data to identify specific aircraft that violate noise reduction procedures. The total cost of this new computer-based monitoring system is estimated to be about $2 million, including approximately $1.7 million from the Airport Improvement Program.

Since the early 1970s, the airport has been documenting noise complaints. It established an airport community forum in 1985 and a noise complaint hotline in January 1988. The community forum provided an opportunity for community, airline, and airport representatives to discuss solutions to noise problems but has met intermittently. However, Los Angeles is planning to reestablish regular forum meetings in 1989 and is expected to focus more on implementation of the Part 150 measures.

Evaluation of Noise Mitigation Measures

Los Angeles has not evaluated the effectiveness of individual noise measures and does not have a mechanism to evaluate its overall noise control program. However, the airport has received some feedback from affected residents on the benefits arising from some of its noise control actions and, through the February 1988 draft environmental impact report, has examined the potential noise effects of proposed development projects and identified additional noise mitigation actions that could be taken. In addition, the airport is in the process of establishing a computer-based program to monitor noise compatibility program implementation.

Status of the Part 150 Program at Los Angeles

Los Angeles has an FAA-approved noise compatibility program under the Part 150 program. Los Angeles performed an airport noise control/land use compatibility study between 1980 and 1984, the results of which were used to fulfill FAA's Part 150 program requirements. FAA accepted the airport's noise exposure map in October 1984, approximately 17 months after the airport submitted it for approval. FAA approved the noise compatibility program in April 1985, 10 months after the airport submitted it to FAA for approval.

As part of its program, Los Angeles has proposed 40 separate noise control measures, of which 28 received FAA approval. The airport has proceeded to implement the noise compatibility plan and has placed priority, in terms of requesting Part 150 funding, on 6 measures—installation of a noise management system, study of runway extension feasibility, residential soundproofing, redevelopment of Inglewood, revitalization of the community of Lennox, and erection of sound barriers in El Segundo—before making commitments on the other 22 measures.

FAA did not approve 12 of the noise mitigation measures submitted by the airport. FAA did not approve three measures, including the use of FAA radar information, early phaseout of Stage 1 aircraft, and development of a capacity control regulation, because the airport did not provide sufficient information for FAA to determine whether the measures met program requirements. FAA disapproved another three measures for several reasons and took no action, pending further evaluation, on two proposed changes to flight procedures because FAA did not have to act on these within the 180-day approval period. Finally, FAA took no action on four measures that were justifications for not adopting specific measures or statements of the airport's position on local funding arrangements for program implementation.

FAA's Role

FAA played a significant role in the airport's development of a noise compatibility program. In 1980, FAA, as a condition of approving an environmental impact statement addressing future airport development, stated that it would not fund the proposed improvements until the airport submitted and FAA approved a noise mitigation package. In 1983, FAA revised the condition to allow runway reconstruction funding as long as the airport moved to complete its noise study in a timely manner and submit it for approval under the Part 150 regulation.

FAA was responsive, but slow, to the airport's needs during the Part 150 process. Although FAA worked closely with the airport to develop its noise compatibility maps, airport officials told us that FAA provided little guidance in the development of the noise compatibility program. They attributed this to personnel turnover and understaffing within FAA. They also stated that FAA was very thorough and involved during the program review and approval process.

Memphis International Airport Noise Mitigation Efforts

Airline operations at the Memphis International Airport (Memphis) increased over 50 percent between 1978 and 1988. To prevent the aircraft noise from these operations from becoming unmanageable, the airport in 1984 began developing a noise mitigation program. Memphis' noise program emphasizes land use compatibility measures as the primary means to mitigate noise. To support the program, the airport operator—Memphis-Shelby County Airport Authority—has issued $20 million in bonds and committed all of its federal Airport Improvement Program funds to financing the estimated $100 million property acquisition program.

Background

The airport is owned by the city of Memphis and was established at its current site in 1929. Since then, the airport has increased its runways from one to five. Current and planned airport construction is designed to further increase the airport's capacity and respond to anticipated growth in air traffic. In 1987, Memphis ranked nineteenth among major airports in the United States in terms of total operations.

Since 1978, the volume of aircraft operations has changed significantly. While the airport's total operations increased by 1 percent between 1978 and 1988, from 349,000 to 353,000, airline operations increased by 53 percent, from 177,000 to 271,000. At the same time, general aviation operations decreased by over 50 percent. The increase in airline operations is due to Northwest Airlines establishing a hub at Memphis and the rapid growth of the Memphis-based Federal Express Airlines.

Although located in Tennessee, the airport is about a mile from the Tennessee-Mississippi border. Noise from the airport significantly affects an adjacent Mississippi county that has experienced rapid population growth since 1980. In the airport's noise compatibility program, the Airport Authority estimated that about 73,000 people lived in areas experiencing noise levels of 65 Ldn or greater in 1985 and projected that 89,000 people would live within that area by 1990. The increase is mainly due to projected increases in air traffic, thus expanding the airport's noise contour, rather than population growth.

Memphis established a noise complaint mechanism in 1986. In 1986, the airport received 90 complaints; while in 1988, the complaints numbered 112. Airport officials believe that noise complaints increased because of the publicity over the airport's development of a noise program. However, the frequency of complaints is currently decreasing, according to an airport official.

The Airport Improvement Program provided the airport with $8.3 million for residential property acquisition in fiscal year 1988 and had previously provided $195,151 for the airport's Part 150 study. The Airport Authority estimates that the total land acquisition program will cost $100 million. Of this amount, the authority anticipates that FAA will provide $80 million, with the remainder to be provided through an airport bond issue and state of Tennessee grants.

Efforts to Mitigate Noise at Memphis

Noise mitigation action at Memphis began in 1979 with FAA's implementation of a nighttime preferential runway-use system and departure flight tracks. FAA implemented these noise mitigation measures to address noise complaints from residential areas in the immediate vicinity of the airport by reducing flights over these residential areas. The airport subsequently restricted the time of day during which engine tests could be conducted.

Realizing in 1984 that noise was becoming a significant problem that would soon need resolution, the Airport Authority hired a consultant to update the airport's development plan and develop a noise compatibility study in preparation for a Part 150 program. A number of noise mitigation measures were considered by the Airport Authority as part of the noise compatibility study; however, not all were adopted. For example, restrictions on ground movement of aircraft and limiting the number of operations or types of aircraft using the airport were not adopted. The Airport Authority did not believe that these measures would significantly reduce noise or be economically feasible. Also, it is the Airport Authority's policy not to limit restrictions on air carrier operations because of the significant economic benefits the Memphis area community receives from the airport.

The study's findings and analyses were provided to several public sources for comment by the Airport Authority. The Technical Advisory Committee, consisting of representatives from FAA, the airlines, city and county planning agencies, and other groups concerned with the noise compatibility program, provided its comments to the Airport Authority. To obtain comments on the specific noise mitigation measures under consideration, the airport established a general advisory committee of people living in communities surrounding the airport. The airport, in 1987, also established the Noise Compatibility Committee—composed of individuals from Mississippi and Tennessee—in an attempt to achieve community participation in the implementation of the final noise program.

Current and Planned Mitigation Measures at Memphis

Memphis is addressing both future airport growth and noise mitigation at the same time. A discussion of the airport's operational, land use, physical, and noise program management actions follows.

Operational

In addition to its preferential runway-use system, departure flight tracks, and nighttime engine test restrictions established by FAA in 1979, the airport has established other operational measures. Prior to the noise study, Memphis established restrictions on nighttime engine tests, and airlines using the airport began using noise abatement departure procedures—power and flap management techniques—designed to reduce noise shortly after takeoff.

Land Use

Memphis is focusing its attention and resources on land use compatibility measures, including those that have not received FAA approval. The Airport Authority began its property acquisition program, primarily for residences experiencing noise levels of 75 Ldn or greater, in July 1987. The airport structured its program to meet community desires identified through an opinion survey and to maintain the continuity of established neighborhoods. The airport has identified a total of 1,225 residences eligible for acquisition. As of February 2, 1989, the airport had purchased 209 residences and received applications for it to purchase an additional 700 residences. The total estimated cost of the property acquisition program is about $100 million.

Although the Airport Authority is currently focusing its efforts on acquiring single-family residences, it intends to acquire undeveloped land as the need arises to prevent incompatible development. In addition, the Authority is considering acquiring churches exposed to aircraft noise levels of 75 Ldn or greater.

The airport's Part 150 noise compatibility program initially recommended adopting land use compatibility measures that included (1) incorporating an aircraft noise overlay in the zoning regulations so that land use compatible with aircraft noise would automatically take precedence over other uses, (2) requiring aircraft noise to be considered in the approval of requests for zoning changes and variances, and (3) requiring acoustical treatment of all new construction in areas subjected to significant noise levels. Although these measures were not approved by FAA,

the Airport Authority intends to work with local governments to implement them. It is currently sponsoring a comprehensive land use study, with the assistance and cooperation of surrounding local governments, to develop land use policies and regulations to prevent additional incompatible development and to encourage positive patterns of compatible development in areas exposed to significant aircraft noise levels. The Authority plans to involve the public in the study.

In dealings with its residential neighbors, the airport is considering a number of actions to ensure equity, including fair disclosure (noise notices), purchase assurance agreements that guarantee to a homeowner the saleability of his residence, soundproofing, and the purchase of easements allowing aircraft to fly over residences. The airport will consider fair disclosure requirements in the current land use study mentioned previously. After the residential property acquisition program has progressed further, the airport plans other actions. For example, it intends to study the feasibility, likely effectiveness, and implications of residential sales assistance—purchase assurance for the seller—soundproofing, and easement purchase as part of a later phase of the noise program.

The airport has encountered some problems in implementing its property acquisition program. One problem is that some residents outside the program boundary lines believe they should be included in the acquisition program. Another problem occurred during the airport's noise study. Over the objections of the Airport Authority, a local developer obtained permission from the City Council to build a subdivision of single-family houses on land experiencing noise levels of 75 L_{dn} or greater. According to the airport's noise program coordinator, these houses probably will become part of the property acquisition program even though the developer was aware that he was building on noise-affected land.

Physical

Other than requiring that engine tests be conducted in specific locations, the airport's current noise program does not include any new measures requiring physical changes to its existing runways, taxiway, or other physical facilities. Although other physical measures were considered by the Airport Authority during the noise compatibility study, none were implemented. For example, the consultant's analysis of runway alternatives showed that the planned placement of a proposed third parallel runway merely reduces additional noise exposure and that a proposed runway extension would not reduce overall noise exposure. Thus, the new runway and runway extension are included in the airport's

development plans primarily to enhance capacity, rather than reduce noise.

Noise Program Management

The airport established its procedure for handling noise complaints in 1986, the same time it created the noise compatibility office. The procedure involves recording complaints as they come in over a phone line established specifically for this purpose. The noise program coordinator personally makes a follow-up call to the complainant to investigate the nature of the complaint and provide information as necessary. These complaints are summarized monthly to help identify potential problems.

As previously discussed, Memphis established the Noise Compatibility Committee in 1987 to assist in implementing the noise program. The committee is chaired by Memphis' noise program coordinator and is composed of 12 individuals from Mississippi and Tennessee. The committee was established to achieve community participation in the noise program through relaying residents' views, concerns, and questions to the airport, recommending noise compatibility actions for consideration, and providing information about the effectiveness of noise compatibility actions.

Evaluation of Noise Mitigation Measures

While Memphis has not formally evaluated the effect of any of its mitigation actions, it plans to periodically evaluate those measures amenable to evaluation. The airport routinely accumulates data on the status of its property acquisitions and noise program funding, but it has not evaluated the results of the land acquisition program in mitigating noise. On the other hand, as part of the environmental impact statement for a new runway, Memphis does plan to analyze FAA radar flight track data to assess the noise effects of and compliance with existing preferential departure procedures, an operational noise mitigation measure.

Status of Part 150 Program at Memphis

Memphis is currently implementing an FAA-approved noise compatibility program under the Part 150 program. The airport submitted the noise exposure maps and compatibility program for FAA's review in November 1986. FAA determined that the maps complied with its Part 150 requirements in September 1987 and approved the noise program in February 1988—about 15 months after its initial submission.

FAA's Role

FAA played an important role by providing guidance to the authority and to the consultants involved in the Part 150 process. FAA also worked closely with the consultant during noise program development and provided comments on draft reports that assessed the impacts of proposed noise measures on safety, airport capacity, airport access, interstate and foreign commerce, and the efficient use of the air traffic control system.

However, according to the airport's noise program coordinator, the criteria for approving noise exposure maps and compatibility programs that were used by the FAA regional office were much different than that used by FAA headquarters. The airport submitted its noise exposure maps and compatibility program together and initially included 26 noise mitigation measures for FAA approval. The local FAA office reviewed the documents and forwarded them to headquarters with the recommendation that they be accepted as meeting regulatory requirements. FAA headquarters returned the documents 4 months later saying that the noise program was not sufficiently detailed and requesting more definitive information on implementation plans and responsibilities. FAA headquarters officials agree that inconsistencies exist among regional and headquarters review processes and plan to report to the Congress in October 1989 on ways of improving the review process and streamlining its Part 150 program.

After receiving FAA's comments, the airport withdrew 19 of the measures from its request because it could not afford to develop the additional information FAA required for approval.

Minneapolis-St. Paul International Airport Noise Mitigation Efforts

Aircraft noise has been a problem at Minneapolis-St. Paul International Airport (Minneapolis) since the late 1960s. As a result, a number of noise abatement procedures have been developed and implemented at the airport to reduce the individuals affected by aircraft noise. Since 1977, the number of people experiencing noise levels within 65 Ldn has declined by over one-half, from about 38,900 to 18,500 in 1987. The airport's philosophy for controlling noise is to (1) give safety priority, (2) reduce noise for as many people as possible when implementing noise measures, (3) consult citizen and professional groups in decisions to reduce or redistribute noise, and (4) develop cooperative relationships with the airlines through voluntary agreements to reduce noise. In August 1984, the airport began developing its Part 150 study and submitted it to FAA in October 1987 for review. Currently, FAA is reviewing the airport's Part 150 study, which had been revised to address FAA's previous comments.

Background

Minneapolis opened in 1928 and is one of seven airports owned and operated by the Metropolitan Airports Commission (Commission) an independent agency created by state law to provide for the efficient development of air transportation facilities in the Minneapolis-St. Paul metropolitan area. Total operations grew from 263,461 in 1978 to 373,851 in 1988—an increase of approximately 42 percent. During the same period, passenger use of the airport increased from 9,357,998 to 17,733,837—an increase of 90 percent.

Operations at Minneapolis affect several communities immediately adjacent to the airport, such as densely populated Minneapolis, St. Paul, Richfield, and Bloomington and growing communities like Eagan and Mendota Heights. Although still very densely populated, Minneapolis's and St. Paul's populations are declining. Several other communities are affected by noise, but to a lessor extent because of their distance from the airport.

Noise complaints have steadily increased, from 601 in 1980, to 16,700 in 1987, and to over 27,000 in 1988. The large increase in 1988 was due to citizen concern over a runway-use test. The Airports Commission summarizes and analyzes noise complaint data monthly and provides this information to the Metropolitan Aircraft Sound Abatement Council (Abatement Council), a citizen group formed in 1969.

Since the late 1960s, FAA, the Airports Commission, and the Abatement Council, have worked together to implement numerous noise abatement

procedures at the airport. For example, one of the earliest, continuing measures established at Minneapolis was the preferential runway system. FAA implemented it in 1971 at the request of the Airports Commission and the Abatement Council. Subsequently, additional noise abatement measures were implemented at the airport, including flight track modifications, noise abatement takeoff procedures, and airport modifications to reduce noise.

In 1981, the Minnesota State Legislature enacted legislation that required the Commission to develop noise abatement plans containing specific annual reductions in maximum hourly noise levels and to annually report on its progress in meeting the plans' objectives. In 1981, the Airports Commission adopted a Noise Abatement Operations Plan for Minneapolis. Its intent was to identify the most effective operational techniques available for limiting airport-generated noise to the smallest possible area. In addition to maintaining existing measures, the plan recommended, among other things, banning training flights and aircraft not meeting specific noise limits, relocating cargo facilities, and initiating differential landing fees. As of July 1989, the Commission banned training flights and aircraft not meeting specific noise limits.

Part 150 noise compatibility planning costs as of January 1989 were $222,800, with the airport receiving $116,000 in 1984 under the Airport Improvement Program noise set-aside provisions. According to our analysis of Part 150 study documents submitted to FAA for review, anticipated costs to implement the noise measures will be at least $84.9 million, primarily to increase land use compatibility.

Efforts to Mitigate Noise at Minneapolis

Since 1969, several groups—including the Abatement Council, with representatives from the private sector, aviation industry, and government entities—have worked with the Airports Commission to reduce airport noise. They have contributed to the various noise abatement measures implemented by the airport.

Organizations for Mitigating Noise

Until 1985, the Abatement Council was the primary group concerned with reducing airport noise. Since then, additional groups have been formed to address the issue of airport noise reduction. These groups were the Governor's Task Force on Airport Noise and the Noise Implementation Working Group.

The Abatement Council, which the Commission views as its primary link to the public, was formed by a group of private citizens and aviation industry representatives as an advisory body to the Commission. Its membership currently consists of representatives from the Commission, FAA, aviation industry, and communities around the airport. It plays a key role in the analysis and development of noise mitigation measures at the airport. For example, the group was instrumental in developing noise mitigation measures implemented in the 1970s and the 1982 Noise Abatement Operations Plan. On behalf of the Commission, the Abatement Council began developing the airport's Part 150 study in August 1984. Consultation and coordination with FAA, other federal agencies, and state agencies and the opportunity for public review, as required by the Part 150 regulations, were accomplished through the Abatement Council, the Metropolitan Council, and the Commission. The Metropolitan Council, which develops planning guidelines for local jurisdictions and helps them prepare and implement local comprehensive plans, participated in development of the Part 150 Land Use Management Plan. As discussed below, the Governor's Task Force and the Commission's Noise Implementation Working Group conducted noise reduction studies concurrent with, but outside of, the work of the ongoing Part 150 study. However, their evaluations and recommendations were included in the study.

In October 1985, the Governor of Minnesota established the Governor's Task Force on Airport Noise to examine the problem of jet noise in communities surrounding Minneapolis and to evaluate potential solutions at the federal, state, and local level. The task force was comprised of representatives from a larger constituency than that of the Abatement Council and included persons from state and metropolitan agencies, state legislators, representatives from local units of government, and private citizens. In January 1986, the task force recommended a noise abatement program that called for the commission, the state, and the airlines to negotiate a schedule for reducing airport noise. In addition, the task force recommended (1) adopting and enforcing land use compatibility guidelines, (2) soundproofing schools, homes, and public buildings on a voluntary basis, (3) limiting home acquisitions in the highest noise areas, and (4) reducing taxes for homes affected by aircraft noise.

Realizing that earlier noise studies each contained a recommended program for controlling aircraft noise at Minneapolis and that in some cases there was redundancy among them, the Commission, in April 1986, attempted to combine the studies into a single noise abatement program through its Noise Implementation Working Group. The working group

included representatives from the Metropolitan Council, the Minnesota Pollution Control Agency, and the airlines. It also included community representatives, the Abatement Council, FAA, and the Commission. Results of the group's work led to the development and eventual adoption of a new noise abatement plan in April 1986 that recommended reducing Stage 2 aircraft use at Minneapolis through a noise budget that would allow each airline a fixed amount of noise over a specific period of time, limiting the expansion of corporate and general aviation, soundproofing schools, improving the preferential runway system, and encouraging general aviation to transfer activity from Minneapolis.

Despite its actions and extensive public participation in noise program development, the Airport Commission has been unable to satisfy all concerned parties. For example, two of the more prominent community groups concerned about airport noise are the South Metropolitan Airport Action Council (Airport Action Council) and the St. Paul Airport Noise Coalition (Noise Coalition). These two groups were dissatisfied with the commission's efforts to mitigate noise and felt that the commission, as a local airport operator, had no real authority to implement noise measures. The Airport Action Council was also dissatisfied with the entire Part 150 noise program and believed that more emphasis should have been placed on operational measures than on land use solutions, which it believed would threaten neighborhood stability.

Current and Planned Mitigation Measures at Minneapolis

The Commission has worked many years to develop and implement noise mitigation measures at Minneapolis. They have, with FAA assistance, implemented operational changes, implemented actions to reduce incompatible land uses, implemented physical changes, and developed ongoing activities to manage their noise program. The Commission plans to implement additional measures recommended in its Part 150 study.

Operational

The Commission began implementing noise abatement operational measures in 1971 when FAA, at the Commission's request, implemented a preferential runway system. Since then, with FAA's assistance the Commission also has modified approach and departure procedures, restricted engine runups, and banned general aviation instrument training and noisier aircraft from access to the airport. In addition, it has had air carriers voluntarily limit the aircraft noise they generate.

Although use of the preferential runway system has declined since 1980, it continues to be one of the primary measures in the airport's

overall noise abatement plan, and the Commission is taking steps to increase its use, despite the controversy that this has engendered. Preferential runway use had declined because increased traffic required more frequent use of higher capacity runway configurations, which shifted additional aircraft noise to the more noise sensitive residential areas. Because of this, the Commission began reassessing the preferential runway system in late 1987, with the objective of achieving a more equitable distribution of aircraft noise. FAA, under the Commission's recommendation, suspended the preferential runway system for 180 days to test a revised runway-use system intended to achieve more equitable distribution of noise. Community residents who would be receiving more noise under the test filed suit to prohibit it, but they were unsuccessful. The test was conducted from July 1988 through January 1989. On July 10, 1989, the Commission released its analyses of test results to the Abatement Council, which will conduct public reviews of the results and recommend a course of action to the Commission. Actions planned to increase preferential runway use include extending the crossing runway, encouraging general aviation aircraft to relocate to other Commission-owned airports, and having FAA assign propeller aircraft to designated runways.

In April 1987, the Commission considered a noise budget ordinance, limiting and allocating the total aircraft noise airlines could generate, for inclusion in its Part 150 noise study. However, the Commission was able to achieve faster implementation by negotiating voluntary noise budget agreements with air carriers serving the airport. The ordinance would have (1) set a cap on total noise produced by air carriers at the airport, expressed as the Average Daily Noise Energy—a noise measurement system not approved by the FAA—and (2) reduced overall airport noise levels in equal increments over time. Initially, the Commission was to implement the noise budget by ordinance, but FAA persuaded the Commission to change its plans (see below under "Status of Part 150 Program at Minneapolis"). The negotiated program incorporated noise abatement measures that could be implemented immediately, including commitments from the airlines to acquire quieter aircraft, reduce their nighttime operations, not conduct training flights at the airport, and comply with engine run-up restrictions. Other operational measures implemented at the airport are restrictions on aircraft ground movements and nighttime engine tests, glide slope angle increases, and power and flap management procedure changes.

Land Use

The airport's land use noise mitigation measures emphasize school soundproofing and efforts to implement compatible-use zoning plans and building codes. The airport's proposed Part 150 noise study includes plans to acquire land, purchase easements allowing aircraft to fly over property, and provide purchase assurances in severely noise-affected areas.

The Airport Commission's sound insulation activities began in the early 1980s with a school insulation project, using state and local funds. The Commission plans to complete sound insulation work at four additional schools, including two that are proposed in the airport's Part 150 study, by the end of 1990. The total cost to soundproof the five schools experiencing noise of 65 Ldn is estimated at $5.4 million. The Commission plans to use $800,000 of state funds, $1.8 million of FAA funds, and about $2.8 million of its own resources to finance the work. The Part 150 study also recommends soundproofing over 4,000 private residences within 65 Ldn at an estimated cost of $29 million.

The Commission does not control the use of land and buildings that surround the airport and must rely on community cooperation to achieve compatible land use. This is facilitated by the Metropolitan Land Planning Act of 1976, which requires each community surrounding the airport to prepare a comprehensive land use plan. The Metropolitan Council must then review and approve the plans. To carry out the act and provide community guidance, the council developed land use compatibility guidelines that included zoning and building code provisions and a model building code ordinance for aircraft noise attenuation. Three of the six municipalities around the airport—St. Paul, Eagan, and Bloomington—have implemented land use plans that are consistent with the council's land use compatibility guidelines. Although land use plan revisions are under development for the city of Minneapolis, the community does not favor zoning modifications of fully developed residential areas because of their potential to disrupt or reduce property values. Finally, land use plan revisions are under consideration for Mendota Heights and Richfield.

Physical

Minneapolis, for the most part, did not make major changes to airport facilities or their locations to control or mitigate noise impacts. Changes made to facilities, such as terminal expansion and high-speed exit taxiways, have been primarily for capacity and operational enhancement rather than noise control purposes. Minneapolis does have perimeter noise barriers to shield adjoining communities from airport noise and

has rehabilitated its engine maintenance and run-up area at an estimated cost of $1.6 million.

The airport also plans to extend a runway and displace its threshold to improve preferential runway system capacity and decrease aircraft noise over heavily populated areas. Communities surrounding the airport feel differently about the planned runway extension depending on their location. For example, Bloomington and Richfield residents are against the extension because it would result in more noise over their communities. South Minneapolis residents, on the other hand, do not object because it would reduce noise in their neighborhoods.

Noise Program Management

The Commission's noise program management efforts are consistent with its philosophy on noise mitigation and control, which, in part, is to consult citizen and professional groups when decisions are being made to reduce or redistribute noise. To this end, the Commission established a citizen complaint phone line in 1969, supported forums that allow communities around the airport to participate in the noise mitigation process, and conducted airfield and community noise monitoring to assess the effectiveness of the noise mitigation program. The monitoring system was initially installed in 1974, expanded in 1978, and updated with new equipment in 1984 at a cost of $190,017. The Commission has allocated $1.2 million to acquire a permanent noise monitoring system for the metropolitan airport area. In 1988 the airport spent $671,000 to administer and support its noise abatement activities.

Evaluation of Noise Mitigation Measures

Except for studies done during development of the Noise Abatement Operations Plan and the Part 150 Noise Compatibility Program, which evaluated both existing and proposed noise abatement measures, the Commission has not evaluated the specific impact of individual noise measures after they have been implemented. It also does not have a formal, ongoing evaluation system to evaluate the effectiveness of individual noise abatement measures that have been implemented. The Commission views its noise program as an overall program rather than as a series of individual measures. In response to Minnesota state law, the Commission has been reviewing and reporting on the results of its noise abatement program annually. The reviews are based on complaints received, biannual questionnaires and surveys completed by airlines regarding their maintenance and operations, clearances requested by the airlines for engine run-ups, and mobile and permanent noise-monitoring stations. On the basis of these reviews and changes in aircraft

operations, the Commission considers changes to its overall noise program.

Status of Part 150 Program at Minneapolis

The airport's primary purpose in participating in FAA's Part 150 noise compatibility planning process is to obtain access to the noise set-aside funds for off-airport noise mitigation projects. However, airport officials are concerned whether sufficient funding will be available once the noise program is approved. Minneapolis began developing its Part 150 study in August 1984. Three years later, in October 1987, it was submitted to the FAA region for formal review. FAA provided written comments in September 1988. In February 1989, the Commission, its airport consultant, and local and regional FAA officials reached agreement on the changes needed to the study's format and content. In June 1989, the Commission resubmitted its study to FAA. As of July 1989, FAA was reviewing the revised study. Thus, over 21 months after submittal, the airport's noise study has not been deemed in compliance with Part 150 requirements.

Commission officials say that by not having an approved Part 150 program, they have been unable to begin their large-scale, off-airport home insulation program. However, even if FAA does not approve the study, the Commission's planned on-airport noise control measures can still be implemented because FAA has not made them contingent on Part 150 funding.

FAA's Role

Local FAA officials provided the airport with assistance in developing its Part 150 program. However, airport officials were not fully satisfied with FAA's participation in the Part 150 noise mitigation process, primarily because of inadequate program guidance, inconsistent program review approaches, and the duration of FAA's review. FAA contributed to the airport's noise abatement efforts through participation in the Abatement Council and its land use subcommittee, where it provided technical support and advice. FAA also provided written guidance during the study's development of the proposed noise budget ordinance. The guidance voiced FAA's grave concern that the ordinance would potentially result in an impermissible burden on interstate commerce. The guidance also took exception to the noise budget ordinance proposed in the Part 150 study because the Commission (1) used a noise measurement system that was different from the measurement system FAA has established, (2) did not analyze the economic impact of the noise budget on the air carriers serving the airport, and (3) did not analyze the possible burden,

if any, the noise budget would place upon interstate commerce. Nevertheless, the Commission essentially implemented the noise budget by obtaining voluntary cooperation from the airlines.

Commission officials believe that FAA should provide better written guidance on developing the noise study by specifying an FAA-approved noise study format, the appropriate content of a program submittal, and allowable operational measures that the Commission can take to mitigate noise. The Commission's most prominent criticisms of FAA's review of the submitted Part 150 study were the extended time FAA took to review the study and the inconsistencies in FAA's review criteria. For example, almost 1 year passed before FAA completed its initial review of the study for consistency with Part 150 requirements and notified the Commission that it did not meet these requirements. In addition, the FAA region, and not headquarters, rejected a noise compatibility program format that had been previously accepted by FAA headquarters and another FAA region. FAA officials in headquarters recognize these shortcomings in administering the Part 150 program and are currently drafting a report to be issued to the Congress in October 1989 that will discuss ways to streamline the program.

Philadelphia International Airport Noise Mitigation Efforts

Aircraft noise effects from Philadelphia International Airport (Philadelphia) on surrounding communities are generally limited because of noise compatible land uses and the airport's location. Plans for Philadelphia's development began in 1925. Philadelphia is located on a cape-like protrusion into the Delaware River, which minimizes aircraft noise effects and serves as a boundary with the adjacent state of New Jersey.

Philadelphia is experiencing flight delays due to capacity constraints and is conducting a $3.7 million study to evaluate runway development as a means to increase capacity at the airport. Airport officials realize that expanding the capacity of the airport could also increase aircraft noise in some communities. Therefore, to mitigate current and future noise effects, the airport is currently expanding its noise mitigation program.

Background

Philadelphia lies in the northeast corridor, a high density air traffic area between Boston and Washington, D.C. Philadelphia serves as the major airport for the tri-state Delaware Valley Region and, as of 1987, ranks as the thirteenth busiest airport in the United States. Since 1983, the airport has experienced growth in its aircraft operations from 324,729 in 1983 to 417,941 in 1987. In 1987, approximately 40 percent of Philadelphia's air traffic was composed of commuter operations. In addition, Philadelphia currently serves as a hubbing operation for U.S. Air. The airport is owned and operated by the city of Philadelphia through its Commerce Department's Division of Aviation.

Although the Pennsylvania Transportation Department is striving to develop and tighten zoning ordinances statewide under the state's 1984 Airport Zoning Act, one Philadelphia official told us that, for the most part, current zoning regulations and land uses surrounding Philadelphia are compatible with the noise environment of the airport. In addition, most of the land surrounding the airport is generally zoned for industrial or commercial uses and includes large areas of government land and two parks.

Philadelphia has no control over land use in New Jersey. Nevertheless, the airport attempts to inform the appropriate New Jersey community officials of traffic patterns and airport plans to alleviate future noise concerns within these communities.

Efforts to Mitigate Noise at Philadelphia

Between 1980 and 1987, several efforts were initiated at Philadelphia to address the noise effects and study potential noise mitigation measures. These include

- a joint Environmental Protection Agency (EPA) and FAA study conducted and reported to Congress in 1980;
- an update of Philadelphia's noise contours in 1984 as part of the 1987 master plan, which included an environmental overview on noise;
- an environmental assessment conducted in 1986 to assess the impacts of a proposed United Parcel Service facility at Philadelphia; and
- a 1987 study of the airport's noise effects on several southern New Jersey communities.

These efforts, as discussed below, have demonstrated that Philadelphia does not have a major noise problem.

In 1980, EPA and FAA, assisted by the Delaware Valley Regional Planning Commission,[1] submitted a report to the Congress entitled Effects of Airport Noise on a Neighboring State. The report was required by Section 8 of the Quiet Communities Act of 1978 (P.L. 95-609) out of congressional concern that aircraft noise from some airports could affect communities located in another state. Philadelphia was the nation's only airport fitting the selection criterion. The study addressed the airport's noise condition and the potential effectiveness of various noise mitigation measures. The study reported that the most effective noise control option for Philadelphia appeared to be a reduction in nighttime operations, in combination with a preferential runway-use program that would disperse nighttime flights away from populated areas. In addition, the study reported that the population and homes affected within the 65 Ldn noise contour were approximately 37,574 and 11,478 respectively.

Noise contours were developed for Philadelphia's 1984 condition during the master plan update ending in 1987. The 1984 noise contours were substantially smaller than those for 1980, resulting in a decrease in the number of individuals and homes within the 65 Ldn noise contour. One reason for the decrease is that substantially noisier aircraft were in use in 1980 than in 1984. The 1984 65 Ldn noise contour covered an area of approximately 15 square miles, including portions of two residential

[1]The commission developed an Advisory Committee to provide guidance, technical advice, and assistance during the course of the study. It included federal, state, city, and county agencies as well as commercial air carriers and private citizens.

areas to the west. The number of individuals within the 65 Ldn was unknown at this time, although 310 residences were within the area, down from over 11,000 in 1980. The 75 Ldn noise contour lay mostly on airport property or over portions of the Delaware River and did not contain residences.

A United Parcel Service facility, proposed for Philadelphia in 1984 and currently under construction will add approximately 38 nighttime operations when in full operation. An FAA-required environmental assessment demonstrated that the service facility would not have a significant adverse noise effect on the communities surrounding the airport because no community within the 65 Ldn contour would experience an increase of 1.5 Ldn or greater. This conclusion was based on FAA policy that defines a significant increase, or adverse noise effect, as 1.5 Ldn or greater if within the 65 Ldn noise contour.

Because of concerns over aircraft noise in several southern New Jersey communities, Philadelphia conducted a noise-monitoring program in 1987 to determine whether these locations were experiencing high noise levels. The program consisted of three studies, including air traffic levels, aircraft noise levels, and airport operations. Two types of noise monitoring were conducted—continuous and spot checks of single events. The noise-monitoring program found that the community noise levels in southern New Jersey were reasonably consistent with their measured 1984 values. Therefore, because federal funding is not available for areas with less than 65 Ldn, Philadelphia took no action to mitigate the noise.

Because of the small number of complaints received over the past few years, the airport has neither established a telephone hotline system for receiving and addressing noise complaints nor maintained records of complaints. It instead refers all complainants to FAA for action. In recent years, FAA has maintained a record of each complaint and addresses the complaint by determining the cause for the noise event. According to an airport official, FAA received approximately 25 phoned-in noise complaints for the 2-year period 1987-1988, while the airport has received 1 letter complaint.

Current and Planned Mitigation Measures at Philadelphia

Philadelphia's current noise abatement plan, although not officially referred to as a plan by the airport, consists of operational restrictions and a preferential runway-use system. It was developed in large part, on the basis of the 1980 joint EPA/FAA study. Current and planned measures are discussed below, divided by operational, land use, physical, and noise program management actions.

Operational

During the 1980 joint study, it was determined that Philadelphia's informal runway-use program was operating at optimum for both airport capacity and noise abatement. However, FAA personnel began considering the restriction of one runway during nighttime hours to alleviate noise in one community. In September 1980, this restriction was formally adopted.

Current operational restrictions implemented since before 1980 include a noise abatement departure procedure, including power and flap management; flight track management; and informal engine run-up restrictions. The operational restrictions were implemented in cooperation with the FAA; but because of the time period since these procedures were established, specific information on their development is unavailable. Philadelphia plans on using, when installed, a new permanent noise-monitoring system to assess additional operational restrictions.

Initially, only informal engine run-up restrictions existed because engine run-ups did not create a significant noise problem. However, in the early 1980s engine run-ups were formally banned during nighttime hours to mitigate aircraft noise in surrounding communities.

Land Use

Only one land use noise mitigation measure is currently under development. Airport officials plan to meet with local county commissions to ensure that zoning laws are and will continue to be compatible with the noise environment of the airport.

Other measures—such as land acquisition, soundproofing, and purchase assurance—have not been implemented. Philadelphia considered land acquisition, although it determined that this action was not a viable alternative at this time. Airport officials believe that federal grants would not be available to fund land acquisition actions, because of the limited number of residences within the 65 Ldn. In addition, the airport has not requested funding for soundproofing homes or purchase assurance because of the limited number of homes within the 65 Ldn contour.

Physical

Various physical changes at Philadelphia have been considered, but none have been implemented.

Noise Program Management

Philadelphia officials are planning to establish a noise-monitoring system, telephone complaint hotline, and a community participation program as part of Philadelphia's expanded noise abatement program.

A $750,000 permanent noise-monitoring system for Philadelphia will be implemented by mid-1990. The system, among other things, will identify aircraft that violate the airport's noise abatement flight tracks. Repeated violators of the flight track procedures will be penalized, although the penalty has yet to be determined. Philadelphia has requested federal funding to develop and implement a noise-monitoring system.

Airport officials believe the community complaints will increase with increased airport capacity. To address these complaints, the airport plans on establishing a 24-hour noise complaint hotline. Each complaint will be addressed and each complainant will receive a written response. In addition, airport officials are currently developing a proactive approach to working with the local communities on airport-related concerns including noise. This approach will entail going out to the communities to discuss airport activities, such as expansion and improvement plans, and noise concerns at various times during the year.

Evaluation of Noise Mitigation Measures

The 1980 joint EPA/FAA study both evaluated Philadelphia's then existing noise mitigation restrictions and preferential runway-use system for their effectiveness and considered other noise mitigation options. The study found that the most effective noise control option was a reduction in nighttime flights and a preferential runway-use system. In addition, the flight tracks, up and down the Delaware River, were found to be effectively minimizing the noise from flight operations at Philadelphia. Currently, there are no plans to reevaluate those noise mitigation measures already in place.

Status of Part 150 Program at Philadelphia

According to the Director of Aviation for Philadelphia, the airport will not, at this time, participate in FAA's Part 150 program. The Director believes that participating in the Part 150 program would not be beneficial because relatively few homes are within the 65 Ldn. The Director is currently expanding the airport's noise abatement program to help alleviate noise-affected areas and believes this is all that can be done at this time. Airport officials have not sought FAA guidance in their decision to not participate in the Part 150 program. However, airport officials cited several advantages and disadvantages to participating in the Part 150 program.

Several advantages were noted by Philadelphia officials. The greatest advantage would be the federal funding Philadelphia could receive with an approved program. Secondly, a Part 150 program would provide the legal means to, for example, control land use surrounding the airport. In addition, the Part 150 program would clearly define the noise contours and help those homeowners within the 65 Ldn noise contour.

Philadelphia officials include among the disadvantages the excluding of those noise-affected facilities and individuals outside of the 65 Ldn. The airport has relatively few facilities within the 65 Ldn noise contour but has a number of locations in the vicinity with noise effects of 60 Ldn and above. The Director of Aviation believes that the Part 150 program should include facilities experiencing less than the 65 Ldn threshold. In addition, the Director includes as a disadvantage that there may be a lack of federal funding for Part 150 programs after an increased number of airports have approved programs. And because of the prioritization of federal funds for noise projects, airports such as Philadelphia with a limited noise problem may receive little funding.

San Francisco International Airport Noise Mitigation Efforts

San Francisco International Airport (San Francisco) has used noise abatement actions for over 10 years. A primary motivation in developing the airport's noise abatement program is that the airport is subject to California Noise Standards, which required that, by 1986, no residential communities be within the 65 CNEL contour. Those airports not meeting the requirement can receive a variance from the standards if significant steps have been taken to reduce noise. Although a significant reduction in the number of noise-affected homes has occurred since 1981, San Francisco has not yet met the Noise Standard and has received a waiver. In 1977, San Francisco received federal funding for a study that resulted in an action plan whose primary purpose was to define and solve the problems created by aircraft noise. This study became the basis for the development of the nation's first Part 150 program.

Background

San Francisco was built in 1927 and is located on 2,700 acres in San Mateo County south of the city of San Francisco. Established in 1970, the Airports Commission of the city and county of San Francisco is chartered with the authority as proprietor of the airport and has final approval authority for all airport-related actions. San Francisco is the principal commercial facility serving the Bay Area air passenger and air cargo activities. Since 1980, the airport has experienced growth in its aircraft operations from 371,222 in 1980 to 451,132 in 1987. The airport, in 1987, ranked as the eighth busiest airport in the United States. The airport currently serves 31 major international passenger airlines with a 4-runway airfield system.

The airport's location, originally well-removed from noncompatible activities, has been intensively developed in the last 25 years. This location includes approximately 11 neighboring cities with over 100 neighborhoods and a wide variety of commercial, industrial, and institutional facilities. In addition, although the number of homes within the 65 CNEL has fallen by more than half since 1982, complaints have significantly increased. As of December 1981, 8,055 homes were within 65 CNEL, with this number declining to approximately 3,600 by September 1988; but noise complaints have increased from 1,598 in 1982 to 7,316 in 1988. A San Francisco official attributes the complaint increase to the increased number of aircraft within the limited airspace near the airport, which affects surrounding communities.

Efforts to Mitigate Noise at San Francisco

Established and incorporated in 1960 under California laws, as a nonprofit organization, the San Francisco International Airport Sound Abatement Center (Center) served from 1960 to 1975 as the central agency to address noise issues. The Center's voluntary membership includes airlines, the Air Transport Association, Airline Pilots Association, and San Francisco's management. While FAA is not a member of the Center, agency representatives act in an advisory capacity. From its inception until 1975, the Center handled noise complaints and acted in a liaison capacity between the airport and local communities. When the Airport Commission established the Noise Abatement Office in 1974 and installed its noise-monitoring system in late 1975, most of the Center's functions became responsibilities of the new office. However, the Center's trustees and airlines meet monthly to discuss technical issues as well as meet with the general public to discuss specific noise events and complaints.

The Noise Abatement Office has a current annual budget of approximately $600,000. Its early efforts to address aircraft noise included installing a noise-monitoring system and managing a 24-hour telephone complaint system as well as implementing nighttime engine runup restrictions. However, not all attempts to implement noise mitigation measures have been successful. For example, the airport requested four airline operators to consider rescheduling flights from 2 a.m. to 5 a.m. Only one airline accommodated the airport's request.

In 1980, the Airports Commission adopted the recommended actions of a Joint Land Use Study prepared by the airport as a framework within which the airport would attempt to mitigate noise in areas surrounding the airport. San Francisco received a planning grant from FAA in August 1977 to study airport noise control and land use compatibility. During the study, the airport and a consultant evaluated 36 on- and off-airport noise mitigation measures to determine their potential benefits and costs. As a result, an action plan of 23 specific measures, in 6 related areas, was recommended for implementation. Other measures, such as land use zoning or land acquisition, were not implemented. Although the Airports Commission actively opposes incompatible land use zoning, the airport is located in San Mateo county where the Commission has no zoning authority. Acquisition of land with incompatible uses was not implemented because of the significant physical and social impacts to existing residential neighborhoods.

In addition to the Airports Commission involvement, the development of the action plan included significant public involvement. Representatives

of 31 units of government or planning agencies at local, regional, county, state, and federal levels participated at different stages in the development of the action plan. A consultant performed the necessary technical analyses, assisting the commission and the public. The results of this study were evaluated under the Part 150 program and approved by FAA in July 1983.

FAA has provided San Francisco $8.1 million in Airport Improvement Program funds from fiscal year 1982 through fiscal year 1988 to develop and implement noise mitigation actions.

Current and Planned Mitigation Measures at San Francisco

San Francisco's current noise abatement program builds on past measures and is a mixture of operational, land use, physical, and noise program management actions. Current and planned measures are discussed below.

Operational

San Francisco currently utilizes a variety of operational procedures and restrictions including preferential runway use, flight track management, engine run-up restrictions, airline rescheduling, and airport use restrictions. Its preferential runway-use system, first implemented in the 1960s, was updated in 1988. Since the 1970s, a variety of departure procedures and flight track management techniques have been implemented to reduce noise in several communities near the airport. In 1979, the airport developed nighttime engine run-up restrictions.

The Airports Commission implemented two noise mitigation measures involving restrictions on the number and type of aircraft flying into San Francisco. In the first, through a noise regulation the airport banned all Stage 1 aircraft by January 1985. The Airports Commission revised the noise regulation in January 1988 to limit the number of Stage 2 aircraft operating at the airport through a phased approach and restrict the use of Stage 2 during nighttime hours. This phased approach began in January 1989 and will result in airlines using Stage 3 aircraft for at least 75 percent of their operations by 1999. A date for 100-percent usage of Stage 3 aircraft has yet to be determined. FAA is opposed to the measure and is concerned that neither the noise benefits nor the effects on air commerce have been fully studied to justify this noise regulation.

Secondly, the airport banned Boeing Q707 Stage 1 aircraft retrofitted with hush kits to meet Stage 2 requirements. The FAA and the Airports

Commission, as of June 1989, are in litigation over the restriction because FAA believes the policy is unjustly discriminatory. As a result of this ban, FAA has withheld Airport Improvement Program funding from the airport. As of April 1988, FAA's withholding of program funds, other penalties, and legal fees has cost San Francisco approximately $25 million.

Land Use

San Francisco's only noise mitigation measure involving land use has been to sound insulate homes and schools. First implemented in 1984 through the airport's Part 150 program, approximately 700 homes and 3 schools became eligible for soundproofing at an estimated cost of $8.2 million in federal funding and $1 million in airport funds. The homes and schools are located in three cities with the local governments responsible for managing the soundproofing program. As of July 1989, 201 homes and 3 schools have been soundproofed for approximately $3.3 million with 67 homes currently undergoing soundproofing.

Physical

Various physical changes at San Francisco have been considered, but only one—a displaced runway threshold—has been implemented to mitigate aircraft noise. A displaced runway threshold reduced the runway length normally available for aircraft arrivals and/or departures. In 1975, a displaced threshold was implemented in response to nearby freeway construction and not specifically to reduce aircraft noise. However a 1982 reexamination recognized the aircraft noise mitigation benefits from the displaced threshold, and the physical change was left in place.

The Airports Commission, in January 1989, authorized a feasibility study to reconfigure the runway-use system by extending one runway and constructing another to increase capacity. This reconfiguration would have positive noise effects because it involves backfilling portions of the San Francisco Bay, thus placing arriving and departing aircraft further from populated areas.

Noise Program Management

San Francisco has implemented several program management noise mitigation measures, including a noise-monitoring system, 24-hour noise complaint hotline, and a community participation program. San Francisco installed a 12-monitor noise-monitoring system in 1975. Since then, the airport has added 16 monitors and improved the system's technical sophistication so that the airport can identify each departing aircraft and its related noise emission data. According to airport officials, the

noise-monitoring system is one of the most sophisticated systems in the United States and has cost approximately $1.9 million. San Francisco implemented a 24-hour noise complaint hotline in the early 1970s and in 1982 began preparing written responses within 30 days to each complaint received. San Francisco also regularly distributes noise complaint information to the general public. In June 1981, as part of the Joint Land Use Study, community participation in noise reduction was enhanced through the establishment of the Airport/Community Roundtable. The Roundtable members include representatives from eight cities, the Airports Commission, San Mateo County, and the city and county of San Francisco. Roundtable meetings are held monthly to discuss current noise issues and noise mitigation actions and plans.

Evaluation of Noise Mitigation Measures

Evaluation of the potential effects of each noise mitigation measure occurred during the 1980 Joint Land Use Study. However, an airport official told us that none of the implemented measures have been evaluated since that time and no evaluation of their individual effectiveness is planned. Airport officials are required to provided quarterly noise reports to the state of California. These reports, with the use of the sophisticated noise-monitoring system, provide information on the effectiveness of San Francisco's entire noise mitigation program.

Status of Part 150 Program at San Francisco

In 1982, San Francisco submitted the noise exposure map produced from the Joint Land Use Study and a proposed noise mitigation program to FAA for evaluation and approval under the Part 150 noise compatibility program. FAA approved the noise exposure map and noise mitigation program in July 1983.

San Francisco developed a Part 150 noise compatibility program for several reasons. According to an airport official, the program establishes a process whereby the airport, airlines, and the public can openly discuss noise issues and noise mitigation plans. The program also has afforded the airport legal protection from lawsuits of new residents in noise-affected areas. In addition, federal funding is made available to conduct the noise mitigation projects.

Several drawbacks were also cited regarding the Part 150 program. For example, developing the Part 150 program is a comprehensive effort requiring a significant investment in time for completion. An airport official also believes that the program, once approved, is relatively

inflexible in the ever-changing noise environment. In addition, the program does not thoroughly address the costs needed to implement specific noise mitigation measures versus their noise mitigation benefits.

FAA's Role

San Francisco's Part 150 noise compatibility program was the first in the country and, as a result, FAA worked very closely with the airport during the process. Thus, airport officials believe that the available Part 150 program guidance, accompanied by a checklist and FAA's technical assistance, was sufficient to produce a noise mitigation plan and noise exposure map acceptable to FAA headquarters as a Part 150 noise compatibility program.

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Glossary

Building Code Provisions	Building codes are established to protect the health, safety, and welfare of community residents. Through these codes, local governments can require new construction, in areas experiencing significant amounts of aircraft noise, to incorporate sound insulation techniques to keep interior noise levels at acceptable levels.
Citizen Complaint Mechanism	While not directly reducing noise or its impacts, a citizen complaint mechanism, such as a noise abatement office or a 24-hour noise complaint hotline, allows the airport to respond to citizens who complain about aircraft noise. Investigation and analysis of complaints can allow airport operators to identify unwarranted deviations from prescribed noise abatement procedures and help assess the level of community concern over aircraft noise levels.
CNEL	Community noise equivalent level. The state of California requires airports to calculate noise-affected populations using the community noise equivalent level measurement system. This system measures the average daily decibel noise level with a 3-decibel penalty added to evening noise—7 p.m. to 10 p.m.—and a 10-decibel penalty added from 10 p.m. to 7 a.m.
Community Participation Program	These programs provide a means for airport operators to establish and maintain a continuing dialogue between the airport, the airlines, and the surrounding communities. A participation program, which permits exchanges of information, ideas, and concerns, could be limited to development and implementation of noise compatibility programs or could address the entire range of airport-community issues.
Compatible-Use Zoning	Zoning is the exercise of state or local government police powers to designate how land can be used. Local zoning laws can be established or modified to recognize aircraft noise impacts and restrict future incompatible land uses in noise-affected areas surrounding an airport.
Displaced Runway Threshold	A displaced runway threshold reduces the runway length normally available for aircraft arrivals. Its use can help reduce off-airport noise impacts because aircraft are generally higher over a given point, thereby reducing the amount of noise reaching the ground.

Easement Acquisition	The purchase of limited property rights, such as an "avigation" easement, gives the airport operator the right to expose land to noise by compensating the landowner for less than full use of his property in the future. This measure, which is sometime used in conjunction with soundproofing, does not reduce noise but results in the land use being considered compatible with the aircraft noise levels.
Engine Run-Ups	Engine run-ups are loud tests of jet engines performed at specific locations on the airport grounds. The locations are identified during the airport planning process and, if properly located in the airport, can reduce the off-airport ground noise impacts that occur from engine tests required for aircraft maintenance.
High-Speed Exit Taxiways	This airport design feature allows aircraft to leave a runway at a higher speed than would otherwise be feasible. As a result, use of reverse thrust (as a breaking feature) is reduced, and an aircraft spends less time on the runway once it has landed. These taxiways, which can reduce off-airport ground noise, also increase the operational capacity of an airport.
Joint Development of Airport Property	Another government agency joins an airport operator in developing airport-owned land for compatible nonaviation land uses. This allows the airport to achieve compatible use of the surrounding land.
Land Acquisition	The airport operator purchases noise-affected land. Generally, the land purchased is not being used in a manner that is compatible with the noise level it experiences—single-family houses on land that is experiencing noise levels of 75 Ldn or greater, for example. Purchase of the land removes the current incompatible use and prevents the introduction of additional land uses considered incompatible with the airport's noise.
Ldn	Yearly day-night average noise measurement. It is a cumulative noise measurement that averages many single events to arrive at an average 24-hour sound level. A 10-decibel penalty is added to nighttime noise events from 10 p.m. to 7 a.m. The 10-decibel correction is applied to

	nighttime intrusion to account for increased annoyance resulting from noise during that period.
Limitations on the Number or Type of Aircraft Operations	A means to reduce the total amount of noise resulting from aircraft operations by establishing limits—annual, monthly, daily, or hourly—on the number of aircraft takeoffs and/or landings or the type of aircraft operations, such as training flights. A noise budget, which limits the total amount of noise energy that can be generated at an airport, also falls under this definition. Limitations of this type may be viewed as an impermissible burden on interstate commerce.
Limitations on the Types of Aircraft	See "Use Restrictions."
Limited Use of Reverse Thrust	When landing, aircraft will generally apply reverse thrust to slow to a safe speed for taxiing off the runway. The noise generated by this is so loud that it can be mistaken for the sound of engine run-ups that occur at the start of an aircraft takeoff. If the reverse thrust is not needed to stop the aircraft in the available runway length, but is used only to expedite turning off the active runway, the potential for reducing off-airport ground noise exists by limiting or reducing its use.
Moving Flights to Another Airport	Moving flights to another airport is a way to reduce the total aircraft noise generated at an airport as a use restriction. For example, certain flights may be shifted to a reliever airport to reduce the aircraft noise at a busy airport.
Noise Barriers and Test Stand Noise Suppressors	Noise barriers or suppressors reduce noise by blocking the path between the noise source and the adjacent communities. Noise barriers shield the neighbors from ground noise as long as the barrier breaks the line of sight from the engines to the listeners. A test stand noise suppressor absorbs most of the engine noise during maintenance testing.
Noise Budget	See "Limitations on the Number or Type of Aircraft Operations."

Noise Monitoring	Noise monitoring is the electronic recording and analysis of aircraft noise. Although not directly reducing noise, it can be a means of identifying areas subject to high noise levels, verifying the accuracy of computer-modeled noise projections, and enforcing operational noise abatement procedures.
Noise-Related Landing Fees	An airport operator can assess special fees or surcharges on the basis of the noise produced by an aircraft or the time of its operation. This measure will reduce noise if it encourages airlines to utilize quieter aircraft or reschedule operations.
Power and Flap Management	Power and flap management concerns the flight procedures and the pilot's flying techniques during takeoffs and landings. FAA, in an advisory circular, recommended a set of power and flap management procedures designed to reduce noise from aircraft takeoffs. Depending on local housing patterns around the airport, these procedures can be modified to minimize aircraft noise either closer to or further from the airport.
Preferential Flight Track Use	This measure involves the use of arrival and departure patterns that take aircraft over the least sensitive land use areas and affects how, where, and how often the aircraft fly over various neighborhoods, once they are assigned to a given runway.
Preferential Runway-Use System	A preferential runway-use system assigns aircraft to specific runways in order to minimize the number of flights over either the most highly exposed areas or the most densely populated areas.
Purchase Assurance	The airport operator will buy a property at its appraised value, or pay the difference between the appraised value and sales price, if the owner of a house in a noise-affected area desires to sell.
Raise Glide Slope Angle or Intercept	The glide slope is the angle at which an aircraft flies when it is on its final approach to the airport. Raising the glide slope results in the plane maintaining a higher altitude during its descent. Changing the altitude at which an aircraft intercepts the glide slope results in aircraft maintaining a higher altitude until it reaches the glide slope. Each of these

actions can reduce the amount of aircraft noise reaching the ground, but safety considerations must also be taken into account.

Real Property Noise Notices

Prospective buyers of homes near airports receive notification that the property is located in a noise-affected area. The noise notice does not necessarily abolish an individual's right to take later action against the airport because of the undesirable effects of noise. However, it gives the prospective buyer a fair warning of the environmental conditions associated with homes located near the airport.

Relocated Terminals

The locations of an airport's terminals are determined during the airport planning process. Relocating terminals to minimize off-airport noise impacts should be considered when the opportunity or necessity to relocate a terminal arises for some other reason in the master planning process.

Rescheduling of Flights

As a limit on operations, flights are moved from nighttime hours—10:00 p.m. to 6:00 a.m.—to other times when the impacts of the noise are not considered as great. Although total aircraft noise is not reduced, it is shifted to the time of day when people are considered less noise sensitive.

Restriction on Engine Run-Ups

The time of day that engine run-ups can be conducted and/or the length of run-up is restricted by airport regulation. The restrictions generally result in reducing off-airport noise that affects adjacent communities during nighttime hours.

Restrictions on Ground Equipment Use

The operation of equipment, such as auxiliary power units, is limited by the airport, which can control the start-up and shut-down times for ground power units, so that the ground equipment is not kept running unnecessarily. Alternatively, all new ground equipment can be required to meet a given sound level specification based on the manufacturer-supplied noise data. This measure can reduce the ground noise reaching adjacent communities.

Restrictions on Ground Movement of Aircraft	Aircraft are prohibited from moving along airport grounds under their own power. Rather they are required to be towed to or from the terminal and a specified point on the airfield. Other types of restrictions on ground operations could require the pilot to check for delays with ground control personnel prior to starting the aircraft engine. Such "gate hold" procedures reduce idling time, aircraft noise, and fuel consumption. Restrictions of this type are intended to limit ground noise.
Rotational Runway-Use System	This runway-use system distributes aircraft operations off all runways without preference for any one runway. The intent of this type of runway-use system is to spread the airport's noise around the surrounding communities.
Runway Alterations	Runway configurations are established during the airport planning process and are based upon weather conditions, geography, and projected capacity needs. By relocating or adding a runway, an airport can directly affect where noise from aircraft operations will fall on the surrounding area. Changing the length or strength—the load-carrying ability—of a runway can be a noise abatement tool if it allows aircraft operations to be shifted from one runway to another to reduce the noise over highly exposed or highly populated areas.
Sound Insulation of Buildings	Existing noise-sensitive sites that are affected by airport noise are modified to limit the sound energy that can enter the building. This often includes techniques such as air-conditioning, replacing single-glazed windows with double-glazing, lining ventilation ducts, caulking, or adding storm windows and storm doors. Although not reducing overall aircraft noise, this measure reduces the amount of interior noise.
Use Restrictions	Airport restrictions that ban aircraft not meeting specified noise criteria from using the airport, either totally or during a certain time of day. The criteria can be based upon the type of aircraft, class of aircraft, or a noise level specified in FAA's aircraft noise standards contained in 14 CFR 36 and related FAA advisory circulars. However, use restrictions cannot violate existing statutes by placing an undue burden on interstate commerce or unjustly discriminating between classes of aircraft.

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